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AERONAUTICAL REVIEW SECTION

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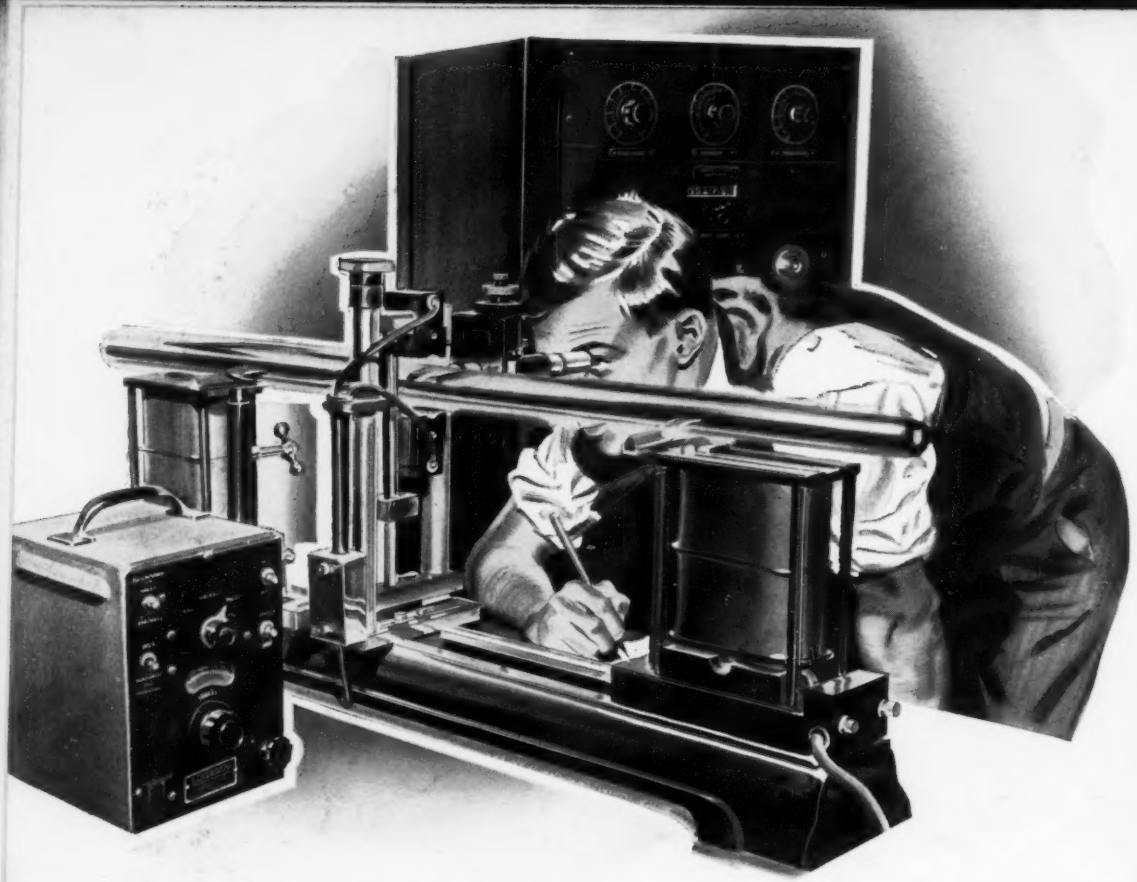

More Power

FOR TOMORROW'S CYCLONES

With the magic eye of the stroboscope, Wright engineers can watch vibration at work on a steel test bar—one of the "guinea pigs" of engine research. The bar, though vibrating through 9,000 cycles a minute, can be made to appear to be standing still.

While the metal is thus arrested for observation, and any evidences of fatigue can be seen, vital facts are learned about the characteristics of the alloy. This is another step toward more power for tomorrow's Cyclones . . . a link in the manufacturing chain which today makes possible the production of more than 1,500,000 horsepower a month for defense.

WRIGHT
Aircraft **ENGINES**

WRIGHT AERONAUTICAL CORPORATION • PATERSON, NEW JERSEY

Division of Curtiss-Wright Corporation

Do you know how many parts we make?

Some of the numerous Goodyear parts and accessories available to aircraft manufacturers

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2 MAIN CABIN — *Airfoam seat cushions and mattresses, rubber flooring, crash pads, window strips, steptreads.*

3 WINGS — *wing floats and wings, bullet-puncture-sealing gasoline and oil tank linings, gasoline hose connections, wing steptreads; hose, gaskets and valves for hydraulic controls.*

4 MOTORS — *vibration-dampener mounts, bullet-puncture-sealing gasoline feed hose.*

5 LANDING GEAR — *magnesium- and aluminum-alloy wheels, hydraulic disc brakes, tires, tubes, Dual-Seal tubes for nosewheels, brake sealing rings and gaskets, hydraulic brake control hose; retracting gear hose, valves and gaskets.*

6 COMPLETE ALL-METAL AND FABRIC-COVERED SUBASSEMBLIES — *wings, nacelles, floats, tail and other surfaces.*

FOR upwards of thirty years Goodyear has been known to aviation as a foremost supplier of airplane tires, tubes, wheels, brakes and many other accessories.

We are also now manufacturing many highly specialized new rubber products essential to modern military aviation, including bullet-puncture-sealing linings for gasoline and oil tanks, and bullet-puncture-sealing gasoline feed hose.

And beyond this, our subsidiary Goodyear Aircraft Corporation is now applying its long experience in aeronautical engineering to the construction of wings, tail and other surfaces — on subcontract for primary airplane manufacturers.

Because experience, dependability and service count more than ever today in expediting the nation's aviation program, aircraft manufacturers are finding our mass-production facilities invaluable in easing their load.

The quality of Goodyear aviation products is evident from the fact that Goodyear is the nation's leading supplier of rubber accessories and related metal parts for aircraft — both commercial and military.

Thus, to the aviation industry Goodyear offers the same service it has extended for many years to both automobile and truck manufacturers, that of a dependable mass-producer of parts and accessories — on a larger scale than ever before.

Airfoam — T.M. The Goodyear Tire & Rubber Company

GOODYEAR

ON YOUR NEW SHIP SPECIFY GOODYEAR AIRPLANE TIRES, TUBES, WHEELS AND BRAKES

Home Defense

THE Paper Hornet is really a good-natured creature, content to buzz around of a summer's day looking for his dinner. But nobody in his right mind would deliberately invade a hornet's nest. Mr. Hornet long ago developed aerial home defense tactics so effective that he rarely is called upon to fight.

But it is not only his sting that earns him the respect of the world—for many insects carry weapons. He is also an amazing flyer. He has the power to take off in a second, quickly gain altitude and execute a neat power-dive to intercept the attacker before he quite knows what struck him.

Just as the power of his wings aids the hornet in the defense of his home, so too may more powerful engines aid in our own defense. The more power American engines can deliver for every pound of weight and gallon of fuel, the more readily can we resist attack.

Since increased power must come through refinements in fuels and engines, the Ethyl Gasoline Corporation regards the research work which its engineers are privileged to conduct in cooperation with aviation technologists as being of the utmost importance. We regard the technical data constantly being developed as an essential link in our national defense armor.

ETHYL

ETHYL GASOLINE CORPORATION, *manufacturer of anti-knock fluids used by oil companies to improve gasoline*

JOURNAL OF THE AERONAUTICAL SCIENCES

AERONAUTICAL REVIEW SECTION

JUNE, 1941

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Trend in Training

THE TRAINING ALMOST OVERNIGHT of thousands of men for aviation's three branches—flight, maintenance and production—has been one of the most outstanding and most publicized notes in the American defense effort. That ever greater cooperation in the training of these groups is being effected testifies to the close relationship between the requirements of the three types of manpower necessary to create and operate an effective air power.

Typical evidence of the growing integration of such training is furnished in the appearance of textbooks like *The Aviation Mechanic*, designed to provide a correlated manual for *both* maintenance men and production workers. Whereas at one time books of instruction usually confined their material to a single phase of training—flight, maintenance *or* construction—and gave bare outlines of the remaining essentials, an increasing number of the newer manuals now afford a more intensive study of all three fields, with emphasis on the practical relationships between them. Training manuals in general are responding to the organized effort of government, industry and schools to bring about a coordination in aviation's three fields of endeavor, looking toward greater efficiency in each unit.

Wanted—a Common Nomenclature

The increasing exchange of technical information between the United States and England is creating a demand for a nomenclature which will be clearly understandable to engineers in both countries. Equivalents in both languages sometimes have differences in meaning which are not only confusing but may prove to be definitely dangerous. The compilation of a complete and authoritative nomenclature of aeronautics is urgently needed. It should define American aeronautical terms and also give their corresponding English definitions.

The Aeronautical Archives of the Institute of the Aeronautical Sciences has compiled a consolidated file of all available aeronautical nomenclatures which could serve as a basis for the compilation of a comprehensive dictionary of Aviation. If such a proposal should receive the approval of some of the National Defense agencies, the Institute would cooperate to the fullest extent in such work.

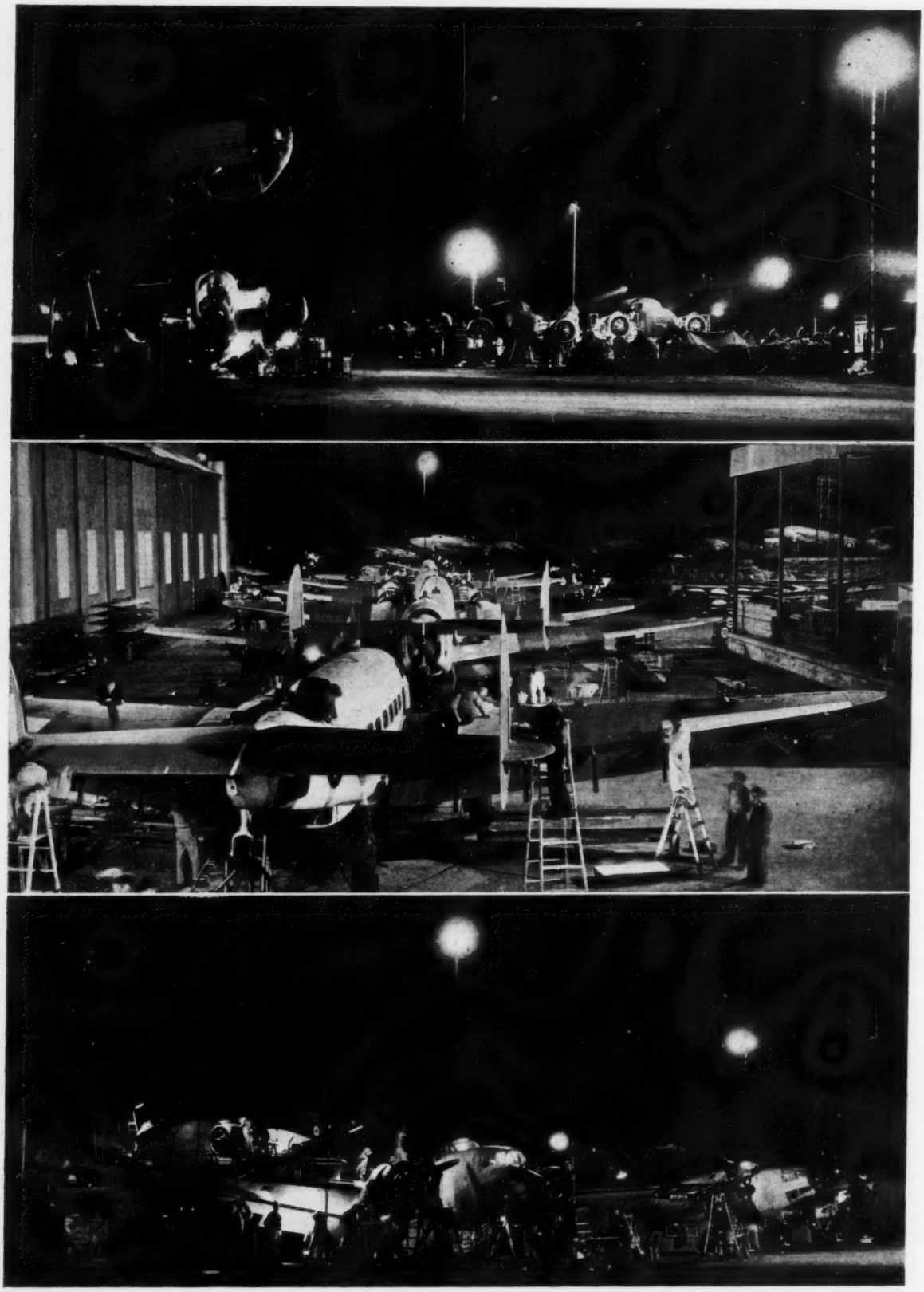
The National Advisory Committee for Aeronautics sponsored a nomenclature, but this needs to be revised and supplemented with additional expressions. The Royal Aeronautical Society would undoubtedly be glad to assist in checking the English terminology. Such a project at this time might have the effect of bringing the English and American nomenclatures closer together by eliminating some of the differences which exist at present.

History in Advertising

The book of P. P. Willis, *Your Future Is in the Air*, reviewed in the April number of the Aeronautical Review, suggests an interesting and highly significant relationship between advertising and the history of industry. Much is written about the men and events, the inventions and discoveries which built air transport—but here for the first time is an account of advertising and its role in the development of air travel as an industry. This book reduces from hypothesis to fact the contention that an industry's advertising depicts more sharply than do records the chart of progress in that industry over a period of time.

The course of any industry lies in its sales—the extent of purchase and use of products manufactured and services rendered. The function of advertising has for many years been regarded as the business of acquainting the buying public with products and services and their uses. But air transport's unique problem was to get people to buy and use something they already knew about but did not want—overcoming the fear factor and making people air-travel conscious. As a result an entirely new field of advertising had to be explored and developed. Anyone who can read or star-gaze knows the rest of the story.

The illustrations and copy in air transport advertising, beginning with the educational campaign of the Ford Motor Company back in 1927 and continuing in today's inspiring advertisements, brings into full view the whole course of the industry from the early scheduled flights down through the successful spanning of oceans as a daily event. The progress in transport equipment, comfort and safety is written into every advertisement. The increase in speed, in number of flights and area served is all there. The results are as much a compliment as a satisfaction to the competant, clever management of the air transport industry.



Outdoor night assembly at the Lockheed Aircraft Corporation, Burbank, California

News Review

April 11. Major General Henry H. Arnold, Deputy Chief of Staff for Air, accompanied by his aide, Major Elwood R. Quesada, left for London to observe military and air war conditions.

April 11. The first U.S. order for barrage balloons was placed with Goodyear Tire and Rubber Company of Akron and the Vulcan Proofing Company of New York.

April 11. The U.S. Navy took over Treasure Island, the site of the recent San Francisco Fair. Work will begin immediately to convert this artificial island in San Francisco Bay into a Naval Air Base.

April 12. Eastman Kodak Company, in its annual stockholder's report, announced a new formula for lens material which is entirely free from silica. Particularly applicable to aerial photography, the new lenses permit a greater degree of refraction without light loss, making it possible to cover greater areas and obtain sharper pictures.

April 13. Air France, backed by the Vichy Government, began negotiations to start air service to the U.S. This move was opposed by a rival company supported by General Charles de Gaulle and the Free French movement, who claimed that the establishment of such a line would constitute a military menace to the United States. British Overseas Airways also announced their intention to resume regular service shortly.

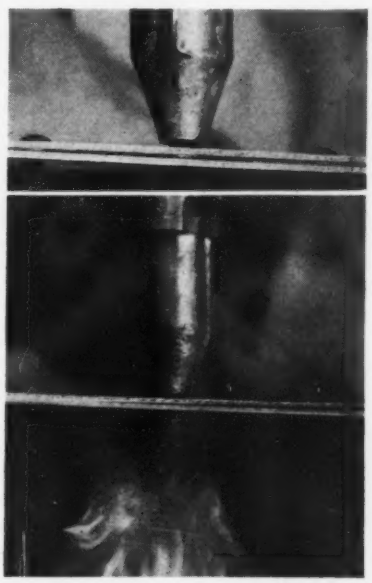
April 14. Major General H. H. Arnold, in his first press conference in London, stated that British and U.S. officials had worked out details for standardization of aircraft equipment for both countries.

April 14. Pan American Airways opened new South American routes which complete the 21-Republic air link. These routes will serve part of the territory formerly reached by *Lufthansa* subsidiaries.

April 15. British Ministry of Aircraft Production announced that a Boeing B-17C, being delivered from Newfoundland to England, broke all existing transatlantic speed records.

April 16. Igor I. Sikorsky established a Western Hemisphere helicopter endurance record of one hour, five minutes and 14.5 seconds at Stratford, Conn.

April 16. Dr. Alexander Klemin, director of the Guggenheim School of Aeronautics at New York since 1925, will retire from that post in September to become Guggenheim Research Professor. He will be succeeded by Charles H. Colvin, acting chief of the instrument division of the U.S. Weather Bureau.



Explosive rivets facilitate airplane manufacture wherever space limitations make it impossible for the ordinary rivet to be bucked. Loaded with gunpowder, the small rivet is exploded by the application of a heat-unit gun; the explosion forces the rivet to buck itself into position. Photograph shows first placement, then explosion of rivet, as used by Republic Aviation Corp.

April 19. The advanced Flying School of the Army Air Corps at Selma, Alabama, was announced ready for service. The new base, on which construction began only eight months ago, has a landing area of 1,000 acres and will provide training facilities for 2,000 students a year.

April 20. Robert H. Hinckley announced that 362 colleges and universities are allowing scholastic credit for work done on the Civilian Pilot Training Course.

April 22. Douglas Aircraft Company announced the completion of the B-19 bomber.

April 23. Col. Gerald Brower, U.S. Army Air Corps observer with the R.A.F., was killed in an airplane accident while on duty in Egypt.

April 25. The Civil Aeronautics Board announced that it would authorize no new air line routes during the present emergency, unless both the Army and Navy agreed that the proposed expansion would not interfere with the defense program.

April 27. Establishment of a nonstop air route between New York and Toronto by Trans-Canada Airlines was authorized by the C.A.B. American Airlines was given permission to extend its Buffalo route to Toronto.

May 1. President Roosevelt signed a C.A.B. order permitting Pan American Airways to link its transpacific service to Singapore by way of Manila, P. I.

May 2. The Bank of America (Calif.) announced the inauguration of a plan for bank-financing of airplane purchases on the same plan as automobiles.

May 3. Richard R. Blythe died in Canada as a result of injuries sustained while acting as an R.C.A.F. instructor.

May 6. Milo Burcham flew the Lockheed P-38 at 458 m.p.h. in its first public demonstration.

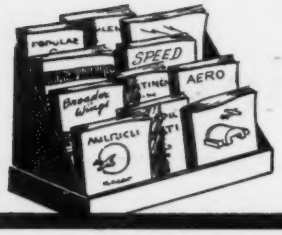
May 6. Sedta, the German-operated air line in Ecuador, ended operations.

May 6. President Roosevelt directed Secretary of War Stimson to take the necessary steps to create a fleet of 20,000 long-range bombers.

May 7. Igor I. Sikorsky broke the world's endurance record for helicopters with a flight of one hour, 32 minutes and 30 seconds. The former world's record of one hour, 20 minutes and 46 seconds was made by a German Focke-Wulf machine in 1937.

May 8. The Senate, by a vote of 44 to 35, eliminated the $800,000 transatlantic mail subsidy for American Export Airlines from the Treasury-Post Office appropriations bill.

May 8. Jesse H. Jones, Federal Loan Administrator, told a press conference that amendments to the Reconstruction Finance Act would permit the government to establish air lines to serve Latin-American countries and other points in the Western Hemisphere.



Periodicals

Aerodynamics

Boundary Layer Removal by Suction. O. Schrenk. An account of a series of tests both in the wind tunnel and in flight, conducted by Prof. Ackert at Zürich on the effect of boundary-layer removal by suction. Examples are given where the application of the blower system in wings resulted in appreciable drag reduction. The accumulated experimental conclusions on suction-flap airfoils were applied to an actual airplane. The results indicated that the wind tunnel and flight data were basically in agreement. *N.A.C.A. Technical Memorandum*, No. 974, April 1941, pages 1–13, 15 illus.

Strange Interlude. A staff article discussing the actual and apparent aerodynamic effects of raising the flaps urges the design and incorporation of some quite simple modification to prevent the pilot from raising the flaps beyond a certain premediatated position by one movement of the control. The effect of flap-raising is here considered in terms of the airflow over the upper wing surface. This flow is actually and completely broken for a second or so during which period the wing loses most of its lift. It is on the basis of this phenomenon that such a flap modification should be designed. *Flight*, April 3, 1941, page 254e.

Description of a Water Tunnel and Apparatus for the Investigation of Flow Problems. A. Fage and J. H. Preston. The closed-return type water tunnel described is especially suitable for the observation of flow near the surface of a long streamline body of revolution at Reynolds Numbers up to 1.3×10^6. The observation chamber is 32 in. long, with a circular cross-section 7 in. in diameter. The stream in the chamber, although slightly disturbed at the higher speeds of flow, is substantially free from turbulence (except near the wall) at all speeds and throughout its entire length.

The tunnel is equipped with two instruments designed for flow observation. The first, called a fluid-motion microscope, allows the movements of small particles in a bright beam of light to be observed and measured. The second instrument is a fluid-motion microscope with an interrupter; it enables the speed of a particle to be determined from a measurement of the length of its track recorded for a known time of exposure on a photographic plate. It can be used to measure the velocity distribution in a boundary layer to a distance of about 0.004 in. from the surface. *Journal of the Royal Aeronautical Society*, April 1941, pages 124–140, 10 illus.

The views and opinions expressed in this section are exclusively those of the writers or publications named. They are in no case to be construed as those of the Aeronautical Review or the Institute of the Aeronautical Sciences.

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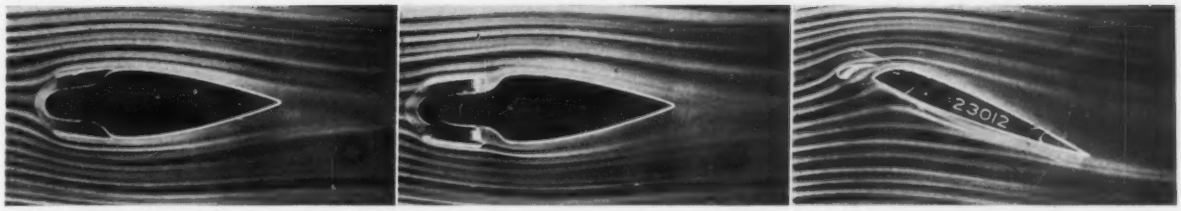
Assisted Take-Off. A verbatim transcription of a special interview with Major R. H. Mayo, inventor of the Short-Mayo Composite airplane, in which he comments on the recently publicized "slip wing" method of assisted take-off presented by Noel Pemberton-Billing. *Aeronautics*, April 1941, pages 68–70, 2 illus.

Directional Stability and Vertical Surface Stalling. George S. Schairer. Vertical tail surface requirements for large multi-engined airplanes are outlined and critical items are discussed. Detailed information is given on the effect of yaw on the flight of the Boeing Stratoliner, showing the development of the vertical fin used on this airplane. The value of the "dorsal" fin in improving yaw characteristics is explained.

Model test information taken from the wind tunnel models of this design was coordinated with flight test figures on the Stratoliner. These indicated the high directional stability of the multi-engined airplane. *Journal of the Aeronautical Sciences*, May 1941, pages 270–275, 10 illus.

Studies on the Subsonic Flow of a Compressible Fluid Past an Elliptic Cylinder. Susumu Tomotika and Kō Tamada. The article sums up an investigation of two-dimensional irrotational subsonic flow of a compressible fluid past an elliptic cylinder placed at an arbitrary inclination to the direction of the undisturbed stream; particular attention was given to study of the manner in which the value of the so-called critical Mach number for the elliptic cylinder varies with the angle of attack as well as with the thickness ratio of the ellipse.

Using the method of Poggi, as in Kaplan's papers, numerical calculations carried out in detail show the values of the critical Mach number



Airflow pictures from the Griswold Smoke Tunnel showing (left and center) how an engine cowl moves slowly upstream when subjected to the air forces of forward motion. This illustrates the characteristic anti-drag effect of diffusors. (Right) High angle of attack flow control to delay the stall and increase lift by means of the Handley-Page type of leading edge slot. Courtesy of C. T. Ludington.

$M_{crit.}$ to be functions of both the angle of attack and the thickness ratio of the ellipse. Results are illustrated graphically. Of interest is the finding that when the angle of attack takes any value different from 0° and 90°, the curve of the critical Mach number plotted against the thickness ratio t has a maximum at a certain definite value of t.

A discussion of further calculations is intended to show that when the value of the angle of attack is fixed, the value of the ratio M_c/M_i for a definite elliptic cylinder increases as the Mach number increases and also that the value of M_c/M_i for a definite Mach number increases slightly as the angle of attack increases, where M_c denotes the moment which an elliptic cylinder experiences when placed in the compressible fluid flow and M_i the moment which the same elliptic cylinder experiences when placed, at the same angle of attack, in the incompressible fluid flow.

Included is a brief discussion of the validity of Glauert-Prandtl's approximate formula for the ratio M_c/M_i. *Report of the Aeronautical Research Institute, Tokyo Imperial University*, No. 201, November 1940, pages 477–551, 6 illus.

Drag of Riveted Wings. Charles Peyton Autry. A report on some N.A.C.A. tests on rivet drag, which becomes an increasingly important factor in the design of higher speed aircraft. The discussion is intended to provide a practical insight of the excess power required in the drag of riveted metal wings with surface laps, applying particularly to small areas at high speeds.

For certain types of wing surface construction and disposition the excess power required is of such an amount that this construction is highly unsatisfactory. Charts for a range of wing areas, Reynolds Numbers and rivet dispositions are plotted to extend a means of estimating the drag in terms of the power increments. These power values have been plotted with the inclusion of a 0.85 propulsive efficiency. *Aviation*, May 1941, pages 53, 54, 4 illus.

Visualized Aerodynamic Research. Roger W. Griswold, II. Airflow pictures comprise the major part of this paper. Before presenting them, the Griswold Smoke Tunnel used for making them is described. Illustrations show some typical flow pictures obtained in the tunnel, mostly of conventional devices, some of which give an idea of the sort of investigations that may be profitably conducted in the tunnel visually.

The tunnel is of the non-return-flow type which is dictated by the need for a continuous supply of fresh air when smoke lines are injected into the flow. The test area, which is spanned by the model so as to give two-dimensional flow, has a high, narrow, rectangular cross-section. A heavy plate glass window is mounted flush with the internal surface in the front face of the tunnel to expose the model to view, together with a field of 24 stream lines.

The power plant consists of a centrifugal blower, belt-driven from an internal-combustion engine, with which combination airspeeds up to 80 m.p.h. can be attained. Exhaust heat from this engine is utilized to activate the smoke-supply apparatus. Smoke is generated by smoldering rotten wood in a special-type stove.

With this equipment a variety of model changes and modifications can be provided, the principle flow characteristics of which can be explored in a fraction of the time (and thus expense) and, in certain elemental respects, more thoroughly than is normally the case for the less flexible three-dimensional quantitative tests. This tunnel is by no means a substitute for the latter equipment, the writer qualifies, but it already has proved to be a useful and convenient piece of supplemental equipment for preliminary and exploratory flow research concerned with aerodynamic problems susceptible to two-dimensional investigation. *S.A.E. Journal*, May 1941, pages 180–187, 32 illus.

They Learned from the Birds. George H. Tweney. This study of the flight of birds harks back to the early days of experimentation with man-made machines. The more adaptable principles of bird flight are pointed out in this article to show their application to modern aircraft design and flying. There is still much that we do not know or understand about the flight of birds, but the practical experimenters of today will eventually provide more of the understanding and information so urgently desired. *Air Trails*, May 1941, pages 25, 46, 8 illus.

Zusammenfassender Bericht uber Arbeiten zur statistischen Turbulenztheorie (Comprehensive Report of Researches on the Statistical Turbulence Theory). K. Wieghardt. Turbulence plays an important part in the application of wind tunnel test results to actual conditions. The results of research on the transition point of the boundary layer and the measurements of frictional resistance are of special importance.

The more recent statistical turbulence theory which has been developed mainly in England and in America, yielded valuable information. Since these individual studies are not easily available, a comprehensive report on the results of this theory was compiled. The statistical turbulence theory gave rise also to an extensive measuring technique. This report treats only theoretical research. *Luftfahrtforschung*, February 1941, pages 1–7, 5 illus.

Accessories

Evolution of Direct Drive Vane Pumps. H. Ray Ellinwood. A study of the development of the vane-type anti-icing pump used for the protection of propellers and carburetors. When the original research from which the pump was developed began over three years ago, it was discovered that most contemporary equipment was deficient in certain desirable characteristics. Among the wanted attributes were: precise and equal metering from multiple outlets; maximum dependability after long inoperative periods; uniform output under varying temperatures and viscosities.

This article outlines the research

which was undertaken in the development of the present Adel Series J anti-icing pumps, indicating the changes which have taken place since the first commercial model appeared in 1939. Present production methods and service routine are also outlined. *Aero Digest*, June 1941, pages 144, 146, 148, 150, 152, 6 illus.

Air Law

Limitation of Air Warfare. Howard S. Leroy. Problems involved in the limitation or control of air warfare are discussed in this article which points out that, as an agency for striking directly at the source of enemy power without over-throwing the armed enemy forces, the airplane has changed completely the technique of warfare. Mobility, speed and range are named as physical advantages of air warfare; limitations are enumerated as: sensitivity to weather conditions; inability of the aircraft to defend itself except when in flight; vulnerability of the individual airplane; increasingly serious need of an elaborate ground organization; limited time of flight and the lack of experience in the use of air power.

Attempts and specific proposals for limiting aerial warfare are reviewed, with the comment that there are no limitations now existing and that attempts at such limitation made in good faith have not been effective. Their failure is assigned to the phenomenal progress of the aeronautical art and the consequences of its application to the technique of totalitarian war which has so integrated air, land and naval warfare that "any attempt at limitation now becomes involved inextricably in general disarmament problems." It is concluded therefor that limitation of air war is not impossible but that its practical realization will be postponed. It is also noted that any limiting regulatory regime can only be imposed on a physical art which is reasonably stable and mature, which stage has not been reached by air warfare up to the present.

A mitigating factor lies in the sanctions imposed by the very ruthlessness of air warfare itself. But, the greatest barrier to any substantial limitation is said to be the surpassing military effectiveness and utility of the airplane. The writer finds in future air power developments the role of a "war-breaking as well as a war-making agency." *Air Law Review*, January 1941, pages 19–33.

Airplane Descriptions

Fleet's Trainer and Transport. The Canadian company's two-place Fleet Model 60 Advanced Trainer is all metal, having semi-cantilever wings with external bracing. Fuselage is semi-monocoque; to facilitate maintenance it is constructed with a bolted joint at the second bulkhead aft of rear pilot's seat and a second joint just forward of the horizontal tail plane. These joints may be arranged so that their strength will exceed that of a normal riveted joint, permitting replacement of any one of three portions of fuselage which may be damaged. Other construction details, specifications and performance figures are noted.

Considerable structural information is given on the Fleet Model 50K Transport, especially designed to accommodate all types of freight. It is a twin-engined conventional biplane having no stagger and little overhang. Built for a useful load of 3,726 lbs., the transport has a cruising speed of 132 m.p.h. and service ceiling of 15,000 ft. *Aviation*, May 1941, pages 60, 61, 4 illus.

The Caproni Ca.310 Libeccio Reconnaissance Bomber. Corresponding to the British Avro Anson, the Ca.310 Libeccio is a two-motor low-wing monoplane designed chiefly for colonial operation. A number of this type are said to have been stationed with Italian squadrons in Lybia, where many were destroyed.

Powered by two 470 hp. Piaggio P.VIIC.35 radial motors, its top speed is 230 m.p.h. at 13,120 ft. Wings are of wood, fuselage of welded steel tube; both are fabric-covered; gear retracts into the motor nacelles. Armament consists of two fixed machine-guns in wing roots, a movable machine-gun in a retractable turret atop the fuselage and a bomb capacity of 880 lbs. Dimensions, weights and performance are noted. *The Aeroplane*, March 21, 1941, page 336, 4 illus.

Airacobras Are Manufactured for Great Britain. Ronald A. Kieth. A complete and detailed description of the export version of the Bell Airacobra which includes data on armament, construction, production procedure and figures, as well as the writer's impressions of the interior and flying arrangement of the airplane. Departures in design which have been incorporated into the Airacobra are defended against criticisms made against it. *Canadian Aviation*, April 1941, pages 27–30, 60, 5 illus.

Fairchild Trainer Selected by R.C.-A.F. The Royal Canadian Air Force, following the results of the primary trainer competition held at Wright Field in 1939, placed an order for $1,500,000 of Fairchild M-62 two-place low-wing trainers. Recently, this type was standardized as the primary training plane for the exiled Norwegian Air Force, and is being manufactured in Canada as well as in the U.S. This article contains a complete structural description of the M-62 as well as performance and power-plant data. *Canadian Aviation*, April 1941, pages 35, 36, 3 illus.

Piper Cruiser. A lengthy description of the handling characteristics of the Piper Cruiser. Its immense popularity is assigned to the fact that "it is about the easiest of all airplanes to fly and learn to fly." *Air Facts*, May 1941, pages 27–33, 1 illus.

Vega-35 Trainer in Production. A study of the construction, power and performance of the Vega-35 all-metal, low-wing primary trainer, giving its performance with five types of power plants. *Canadian Aviation*, April 1941, pages 64, 66, 1 illus.

The Caproni Ca.312 Reconnaissance Seaplane. Two versions of the Ca.311 are in service, the Ca.312b is for reconnaissance and bombing and the Ca.312 I.S. designed for torpedo dropping. Both are identical except that the latter has a long fairing under the fuselage to accommodate the torpedo. Developed, like the Ca.311 landplane from the Caproni Libeccio, the craft is a low-wing cantilever monoplane with twin floats strut-braced to the engine nacelles. It is powered by two 650 hp. Piaggio P.XVI.RC.35 radial engines. Wings are of wood, the fuselage of welded steel tube. Some specification and performance figures are given. *The Aeroplane*, April 4, 1941, page 386, 4 illus.

Yugoslavia's Air Arm. This article was written before the fall of Yugoslavia and describes the design types among that country's air force. Three of these types were of national origin—the Ikarus IK-2 single-place fighter monoplane, powered by one 860 hp. Hispano-Suiza 12Ycrs, 12-cylinder, Vee, liquid-cooled "moteur-canon"; the Rogajarsky R100 fighter-trainer monoplane, powered by one 430 hp. Gnome and Rhone K7 motor; and the Rogojarsky SIM-XIV-H three-place reconnaissance-bomber seaplane, having two 240 hp. Argus As.10c motors. Incomplete data on dimensions, weights and performance of these aircraft are listed.

The remainder of aircraft in the Yugoslav Air Force were of foreign origin, the fighters being Hawker Fury and Hawker Hurricane airplanes, the bombers being the Potez 63,

Dornier Do17, Bristol Blenheim and Caproni Ca.310 Libeccio. The largest aeronautical works in Yugoslavia was that at Novi Sad, which was originally a branch of the German Arado firm and which before the outbreak of the War was producing Hawker Furies and Hispano-Suiza motors under license.

The unit organization of the Yugoslav Air Force and its pilot and ground force personnel are noted in brief. *The Aeroplane*, April 4, 1941, page 384, 3 illus.

Specification and Performance Data on Certified American Airplanes. A tabulation containing the name, capacity, power, dimensions, weight and performance of 92 types of certified aircraft still in use but out of production, and 90 types now being built. This tabulation precedes a directory of U.S. aircraft contained in the issue. *Western Flying*, April 1941, pages 36–39.

The Vega "35." B. A. Martin, Jr. The chief test pilot of Vega Airplane Co. reports on the characteristics and performance of the Vega 35, all-metal, low-wing, primary and secondary trainer now under production. For clean lines, the fuselage, of monocoque structure, and the tail surface are faired together. The design of the airplane and manufacturing rights were purchased from North American Aviation Corp. Several changes have been made to improve flying quality and safety and to facilitate manufacturing. *Commercial Aviation*, April 1941, page 62, 1 illus.

Directory of American Military Aircraft. Photographs, three-view drawings and, where available, dimensions and performance data on over 70 types of trainers, pursuit, torpedo, observation, bombing, liaison and freight airplanes used by the U.S. armed services. *Western Flying*, April 1941, pages 105–144, 97 illus.

Directory of American Civil Aircraft. Detailed descriptions of 91 types of commercial aircraft currently being manufactured in the U.S. Seven types of sailplanes and two autogiros are also included. *Western Flying*, April 1941, pages 40–102, 133 illus.

Fletcher FBT-2 New Plywood Basic Trainer. Designed to cover both primary and basic stages of military and C.A.B. training, the Fletcher FBT-2 can accommodate any engine from the Fletcher A-460, 130 hp., to power plants of up to 285 hp. The airplane is said to duplicate the most modern metal airplanes in performance and design. Its conventional plywood construction is expected to permit immediate large-scale production without drawing on the "already overcrowded metal industry," since the supply of materials as well as all skilled labor, machinery and factory space can be drawn from the furniture industry. Structural design and general characteristics are reported with comment on features. *Commercial Aviation*, April 1941, pages 44, 45, 50, 2 illus.

Canada's First Low-Wing Primary Trainer. In graduating from biplane trainers to monoplanes, the Canadian Government recently tried out a number of American low-winged primary trainers at the Rockcliffe Aerodrome, Ottawa, where each airplane was put through gruelling flight tests, and all available data on each were reviewed. The conclusion of the competition was the selection of the Fairchild M-62 for production for R.C.A.F. training use.

A type pioneered in Canada by the Royal Norwegian Air Force, the Fairchild M-62 is similar in construction to the DeHavilland Tiger Moth, the standard R.C.A.F. trainer until recently. Both airplanes have a fuselage of metal tubing, are fabric-covered from the pilot's cockpit to the tail and have wooden wings; the chief difference is that the M-62 has a plywood-covered wing.

It is said that very little change would have to be made in the DeHavilland plant to handle production of the M-62 and that the general feeling throughout the industry seems to be that DeHavilland will be given the job in Canada. Design, construction principles, instruments and the fuel and controls systems of the M-62 are described at length. *Commercial Aviation*, April 1941, pages 34, 39, 54, 16 illus.

Martin of Maryland. A description of the Martin B-26 medium bomber, its conception and development for mass production is accompanied by highlights on the history and personalities which have gone into the making of Martin aircraft since Glenn L. Martin built his first airplane in 1909. Design factors and production methods used to adapt the B-26 for mass production are noted in brief. *Commercial Aviation*, April 1941, pages 21–23, 54, 9 illus.

Owlet Tricycle Trainer. Paul H. Wilkinson. The General Aircraft "Owlet" similar to its civil version, the "Cygnet," has been adopted by the British for R.A.F. instruction on tricycle landing gear ships and night flying. Its safety characteristics make it eminently suitable for blind approach instruction work as well. It is contended that the early stages of training are much expedited by the use of tricycle trainers. Much detail is given on the construction and design of the Owlet. Specification figures are for the Owlet as a day trainer. *Aviation*, May 1941, pages 64, 65, 4 illus.

The Messerschmitt Multi-Purpose Fighter. At the request of Vultee Aircraft, Inc., a Messerschmitt 110, recently shot down over England, was shipped to California for study by Vultee's engineers. This article is a comprehensive description of the twin-engined fighter, its design, construction, powerplants and armament. Based on measurements and observations made by Vultee's engineering staff, the performance of the captured airplane has been calculated. *Aero Digest*, May 1941, pages 155, 156, 158, 160, 8 illus.

Rearwin Instrument Trainer. A description of the Rearwin 8135T high-wing tandem trainer powered by the 120 hp. Ken-Royce engine. This airplane is equipped with a removable instrument panel in the rear cockpit, making it available as an instrument trainer. It is a modification of the three-place Rearwin Cloudster. A detailed description of the rear instrument panel is given. *Aero Digest*, May 1941, pages 179, 213, 3 illus; *Aviation*, May 1941, page 68, 3 illus.

L'idrovolante Quadrimoter Civile "Cant.Z.511" (The Four-Engined Commercial Seaplane "Cant.Z.511"). Detailed technical description of the four-engined Cant.Z.511, a low-wing monoplane on twin floats. The new craft, powered by four 1,350 hp. Piaggio P XII radial engines, is of all-metal construction, having a wingspan of 134 feet. *L'Aviazione*, March 1941, page 3, 6 illus.

El Dornier "Do.17" (The Dornier Do17). A description of the Do.17 twin-engined semi-high-wing intermediate bomber, giving details of its structure, design, armament, power and performance. *Aeronautica*, December 1940, pages 8, 9, 3 illus.

Taylorcraft Tryout. Selby Calkins. Personal observations on the characteristics and performance of Taylorcraft's new "Duotone Deluxe" model for 1941, as used by the writer on a pleasure flight. *Western Flying*, May 1941, pages 28–30, 4 illus.

Air Policy

Prescription for Progress. W. J. Arnold. The aviation industry is urged to plan a reasoned, thorough program for the future in order to divert into a healthy and vigorous peacetime industry the vast defense expansion in aircraft equipment and manufacturing facilities. In this planning, the bulk of the burden will fall on manufacturers of lighter airplanes, since few of the thousands of military and "semi-civilian" pilots being turned out today can afford to fly, let alone buy powerful airplanes.

Recalling the effectiveness of the "It Pays to Fly" campaign of the air-

lines, it is pointed out that some one organizing force can bring together the various factions of the industry to pool resources and really put their case before the public with profitable results for all. Such a program in the aviation industry should be built upon two general themes—safety and utility. *Western Flying*, May 1941, page 38, 1 illus.

Delusion of Hemisphere Defense. Cy Caldwell. Answering certain prominent isolationists, the writer states his belief that the admonition of George Washington in his Farewell Address to avoid political connection with European nations did not mean that America must go into political hibernation. The Monroe Doctrine creates between the United States and England a sea power partnership which is necessary to the economic survival of both nations.

Replying specifically to John T. Flynn in *Reader's Digest* and Hanson T. Baldwin in the *New York Times*, he states that if the Axis seized ports on the North African coast, we would require a two-continent air force of 100,000 airplanes, 200,000 pilots, 300,000 other air crew members and ground crews of over 1,500,000 men in order to prevent physical possession of the Western Hemisphere by the Axis powers. *Aero Digest*, May 1941, pages 50–54, 149, 150, 3 illus.

Another Gliding Boom? Ralph Barnaby. Nationwide publicity on gliding as a method of air training for defense has brought not only public interest but also moves for congressional appropriations to further glider training. This enthusiasm has brought with it those who would selfishly exploit the renewed interest as well as those who are honestly concerned with furthering National Defense. Glider enthusiasts are cautioned to differentiate between these two and to examine new organizations and legislation carefully before subscribing to or encouraging them. *Soaring*, January–February 1941, pages 1, 7.

Duty over the Atlantic Battlefield. In this editorial it is contended that Germany, having failed to reach her end by the use of air power, has reverted to submarine sea power with the airplane as its auxiliary. Discussing the strategy of the enemy's combined air and sea maneuvers, it is pointed out that British air power must defeat this counter-blockade of Britain's most important battlefield.

The Focke-Wulf escorting of German submarines to reconnoiter for them and provide information on the speed and course of convoys is said to be a serious menace though still "in the nature of an experiment—hence the supporting action of night bombers against British ports." The British problem is to hamper the submarine by destroying its scouts and to diminish the strength of the submarine forces by smashing the yards where they are built and the bases from which they operate.

Surface raiders, carrying their own float seaplanes, also rely somewhat on air reconnaissance. Remaining at sea over long periods by replenishing their fuel and supplies from intercepted merchantmen, they rarely risk interference by land-based aircraft. Efficient detection apparatus is necessary to find these raiders and make effective contact before their offensive is accomplished.

It is concluded that fighters—Blenheims, Beaufighters and the fighter version of the Douglas Boston—will be needed to smash the security and efficiency of submarine and surface raider and to combat night bomber raids on ports. *The Aeroplane*, March 28, 1941, pages 349, 350.

Government Procurement of Aircraft. Arnold W. Knauth. A résumé of Government procurement procedure from World War days to the present traces the development of Federal regulations governing procurement and summarizes factors contributing to successive changes in the procurement system. *Air Law Review*, January 1941, pages 34–39.

Airports

How to Run an Airport. Kurt Rand. Dudley Steele, manager of the Union (now Lockheed) Air Terminal at Burbank, California, outlines the work of a modern airport executive, whose job it is to keep the passenger sold on air transportation after he has purchased his ticket and arrives at the passenger station. Modern air terminal planning for cleanliness, comfort and efficiency are, according to this writer, the airport manager's first duty. *Flying and Popular Aviation*, May 1941, pages 46, 47, 76, 3 illus.

Detroit Gets New Airport. The problem of getting a much-needed new field for Detroit involved many obstacles, politically and otherwise. How the Detroit Airport Committee accomplished its objective is recounted as a help to other communities needing a new airport. *Aviation*, May 1941, pages 52, 136, 2 illus.

Ready-Made Airports One Answer to Congestion. Capt. Robert S. Fogg. Reflecting the growing interest in seaplane flying, the chief of the Seaplane Unit, Civil Aeronautics Administration, suggests that if your community is short of airports you should put floats on your plane and fly it off the water. The thousands of rivers, lakes and harbors in this country offer a natural and logical solution to the airport shortage facing civil aviation. The advantages of seaplane training and flying are enumerated. The objectives and activities of the C.A.A. seaplane unit's program to promote seaplane flying are outlined. *Aviation*, May 1941, pages 32, 33, 142, 144, 4 illus.

Air Transport

What Does Air Travel Cost? A. B. Wescott. The basis of this report is a recent study in the business magazine, *Sales Management*, on the dollar-hour travel cost for five forms of transportation. A firm paying travel expenses for its executives and salesmen should get the most for its money in transportation, particularly when such travel involves a long trip or is made during business hours.

Elucidating tables reprinted with this report show comparative fares by different forms of transportation for trips of varying length and indicate corresponding cost in salary-hours as a result of time lost while traveling during business hours. These comparisons tend to prove the economic superiority of air transportation. *Western Flying*, May 1941, pages 24–26.

Landplanes over the Oceans. No information is yet available on the landplane proposed for use by Pan-American Airways in overseas transport. Indulging in a little editorial guesswork, it is propounded that most likely the airplane used would be made by Consolidated Aircraft and would be large, "perhaps of 90,000 lbs. gross weight," which would call for four of the new American 2,000 hp. air-cooled engines.

Carrying out this assumption, it is estimated that the power loading would be about 11.25 lbs./hp.; the high-wing loading necessary for long-range flight would suggest 38–40 lbs./sq.ft., which would give a wing area of about 2,300 sq.ft.; an aspect ratio of 10 would give a wing span in the neighborhood of 150 ft. *Flight*, April 3, 1941, pages 249, 250.

Air Express and the Air Lines. Donald W. Peters. Like all other methods of transportation, the air lines have found that there is more profit in carrying air express than in passengers, who require space, service and food. In order to clarify air freight's position in both the express

and the transport field, this article sketches the history of commercial express from its beginning as an individual enterprise in 1837, through the struggle for supremacy during the post Civil War era, up to the present, where the air lines are bidding for part of the railroad's business.

The function of forwarding agencies like Railway Express is similar in both rail and air express; that is, selling the service, receiving and fowarding the freight to the carrier on one end, and delivering it on the other. How this business is developing at present and what course is expected in the future, after the war crisis releases equipment, is predicted in this article. *U.S. Air Services*, April 1941, pages 15, 17, 38.

See America! The Air Way. Frederick L. Collins. One of a series of articles on various places to vacation and how to get there. This installment answers the common objections to air travel—comfort, expense, safety and vertigo. Most of these reasons, this article points out, are either popular illusions or remnants of a bygone day of air line pioneering. The advantages, expenses and procedure of transport flying are explained for the layman, and the method of selecting air lines for certain destinations is explained. *Liberty*, April 26, 1941, pages 53–55, 1 illus.

The "American" Way. On December 9, 1940, American Airlines carried its 3,000,000th passenger, becoming the first air line to transport so many passengers. Rapid growth of the company is evidenced by the fact that it took about ten years to carry its first million revenue passengers, two years and seven months to carry its second million and little more than a year to carry its third million. Data on American Airlines traffic are supplemented by statistics and comment on American's operations, personnel and equipment at the close of 1940 and by comparisons in its scheduled service over the last ten years. *Commercial Aviation*, April 1941, pages 29–31, 7 illus.

The R.F.D. Grows Wings. Jennings Randolph. Legislative father of air-mail pickup, Representative Randolph of West Virginia outlines the background and present status of rural air-mail delivery. The idea, conceived some 30 years ago by Dr. Lytle S. Adams, a surgeon, came to light in 1927 when Dr. Adams successfully demonstrated his first full-scale model in the first ship-to-shore mail pickup from the "Leviathan" at sea.

In 1935, the writer became interested in the idea and began boosting it in Congress, which came through in 1938 with appropriations for an experimental feeder service and autogiro shuttle service between post offices and outlying airports. The trial ended May 1940, after a year in which All American Aviation had completed 438,145 miles of scheduled flying, made more than 23,000 pickups without mishap and carried a total of more than 75,000 pounds of mail in growing volume.

How the system works and its future in the eyes of its progenitor are set forth. *National Aeronautics*, May 1941, pages 7–9, 4 illus.

Non-Stop to Europe. James M. Eaton. The new trans-Atlantic air service projected by American Export Airlines to begin this year is outlined by the vice-president of the company. Plans for this and new Latin-American services were evolved from the idea that fast and regular air service over direct, short-cut routes and the highest quality in equipment and accommodations hold the answer to our future on international airways. The realization of this ideal envisions American supremacy in commercial air traffic.

The opening of the proposed service will climax five years of thorough study of routes, traffic, flight facilities and foreign government requirements. It will bring to life the results of numerous survey flights and extensive experiment and planning of the aircraft specially designed for operation of the new routes. Four-engined Vought-Sikorsky VS-44 flying boats, carrying a crew of 11, with sleeping accommodations for 16 passengers, will make the New York-Lisbon run in about 20½ hours, fully loaded with passengers, mail and express.

American Export's projected Latin-American services include expansion of its Transportes Aeros Centro Americanos (TACA) network of air lines in Central America as well as the establishment of new operations to South America through facilities rapidly taking shape. These plans, as presented, reflect American Export's faith in the future of American air commerce and the company's far-sighted preparations for bringing American air supremacy to early maturity. *National Aeronautics*, May 1941, pages 14, 15, 4 illus.

Aerial Freight. Capt. Fred Smith. The Air Express Edition of *Time* magazine, printed on lightweight paper for airmail delivery to Latin America is an outstanding example of merchandizing for aerial delivery. The redesign of the publication permits almost as cheap and rapid delivery to its Latin-American readers as to new stands in this country. The almost infinite versatility of the airplane as a freight medium is exemplified by enumeration of a multiplicity of goods so shipped—all the way from fresh seafood to heavy machinery.

When the present military emergency is over and a large number of aircraft and trained manpower is released, air freight and coach-fare air lines serving small cities are suggested as a means of putting both men and airplanes to work. A general design of airplane to do this work is outlined—a craft built like a box-car, powered with two horizontally opposed engines to act as feeder-line cargo carriers. Built to land in small fields, these airplanes could pick up mail and cargo, carrying them to secondary fields, for transhipment to larger craft like the old Condor type, containing cold storage bins forward of a cabin for fifteen passengers. These, in turn, would make connections with terminal airports, transferring passengers and freight to main line airplanes. This system is forecast as one of the means by which the airplane may be put to its fullest usefulness in the future. *Aero Digest*, May 1941, pages 56, 58, 10 illus.

Armament

5-Gun Turret. Louis Bruchiss. As defensive armament must be flexible, turret-mounting of multiple guns is centering in bomber, patrol and military transport airplanes. The writer describes a new design for a 5-gun battery which he developed and patented in Europe a few years ago; the theory behind this design is explained. Its construction and development were carried through to an adaptation of the variable fire pattern theory to anti-aircraft use. Significant changes in the aircraft armament picture in recent months suggest this multi-gun turret as an improvement over existing types of aircraft fire. *Aviation*, May 1941, pages 44, 45, 146, 148, 7 illus.

Arms and the American Aeroplane. George Herrick. American trends toward improved armament on airplanes now being supplied in quantities to the R.A.F. reflect the experience of the present war; except in certain instances, cruising range is now minimized in favor of better armor and more powerful guns. The Curtiss Tomahawk (P-40) originally mounted four machine guns, but is now being modified to take six and will soon mount eight, with a twelve-gun mount a future possibility.

Air cannon, ranging in calibre from 20 mm. to 37 mm. and firing a highly explosive shell "capable in most instances of knocking out any airplane hit," are being installed on American aircraft for England. The comparatively moderate effect of .30 calibre

machine guns has brought a sharp swing to the .50 calibre gun. The power-driven gun turret, embodying multiple machine guns (from two to five), is now being widely used by American builders. *The Aeroplane*, March 21, 1941, page 338, 1 illus.

Avigation

Aerial Navigation. Wilbur S. Alexander. A summary discussion of the need for air navigation, the nature of the subject, instruments and methods used and how to apply them in flight. *Western Flying*, May 1941, pages 21–23, 42, 5 illus.

Air Navigation, Past and Present. Col. J. C. Fitzmaurice. A comparison between present navigational methods and those applied by pioneer air-mail pilots in the days following World War I. The basic theory of all four divisions of navigation, Air Pilotage, Dead Reckoning, Astronomical and Radio Navigation, is explained. The writer indicates the relation between the theory and practice in the application of all four divisions. *Aeronautics*, April 1941, pages 71, 72.

Astronomical Avigation. (No. 5 of a Series.) Frederick Harrison Tregenza. Dealing with latitude and longitude, this installment demonstrates and explans the principles and methods to be used in determining latitude by meridian altitudes, from Polaris and by circummeridian altitudes. *Commercial Aviation*, April 1941, pages 40, 41, 50, 5 illus.

Planetarium. Fred Hagner, inventor of the Hagner Computer used by the U.S. Army Air Corps for air navigation, has developed a "planetarium" designed to facilitate navigation studies and the astronomy of position.

The instrument consists of an assembly of metallic rings and arcs, graduated in hours and fractions, and degrees, according to their respective functions; a horizon, or azimuth disk, the center of which represents the position of the observer and the periphery of which represents the observer's horizon; and two globes, one terrestrial and one celestial (star), which are interchangeable in the frame with each other, and with the azimuth disk. *Scientific American*, May 1941, page 296, 1 illus.

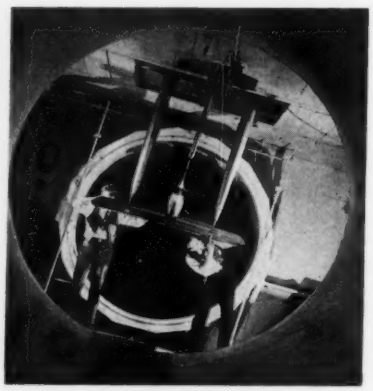
Business and Finance

World Flying and the Future. H. J. A. Wilson. A consideration of economic conditions in the aviation industry after the close of the present war. The writer examines conditions after 1918, and points out that the export market for British aircraft was complicated by the fact that newer and more efficient types were introduced to compete with the 10,000 war surplus airplanes which they were trying to sell abroad. Later, the market was further curtailed by domestic manufacture of aircraft by nations which formerly imported their flying stock.

The best way to prepare the nation and the industry for the economic problems which they must face after the war, the article states, is to determine how the war will influence future prospects, to find out who future customers will be and to prepare to shift production into types which will be usable after peace is restored. *Aeronautics*, April 1941, pages 109, 110.

Design

Differential Motions. Norman Rubin. A mathematical study of the method used to convert straight-line motion into differential motion, as applied in push-pull and cable-control systems of ailerons and flaps. *Aero Digest*, May 1941, pages 134, 136, 207, 8 illus.



Testing a scale model in the Curtiss-Wright Corporation's wind tunnel at Buffalo, N. Y.

Notes on the Messerschmitt. James E. Thompson. Extracts from the technical report on the Messerschmitt 110 made by the engineering staff of Vultee Aircraft, Inc., after studying the example of the type shipped to California after it had been shot down in combat over England. The engineers were most impressed by the striking-power of the craft and the extreme simplicity of its structure. Many of the devices used to allow the loosest possible manufacturing tolerances are described.

Much technical information is given on the design and construction of the airframe, power plants, propellers, instruments and armament. The structure and design are compared with the products of American aircraft manufacturers. *Aero Digest*, May 1941, pages 160, 163, 164, 167, 9 illus.

Preloaded Studs and Bolts. Lt.-Col. J. D. Blyth. Discussing the effect of applying an external axial load to a preloaded bolt, this article demonstrates the importance of taking into account the elasticity of the plate and the bolt. A simple method is shown for detemining the relationship between the preload, the axial load, the residual preload and the reaction at the face of the plate. *Flight*, March 27, 1941, pages 243, 244, 3 illus.

The Slip-Wing Bomber. Noel Pemberton-Billing. Recapitulating his original statements made in earlier articles in *Flight* on this subject, the writer replies to numerous correspondents. The articles in question set forth the principles of the slip-wing scheme for attaining high wing-loading without increasing the length or speed of the take-off run. *Flight*, March 20, 1941, pages 225, 226.

A Note on Wing Design. W. E. Hick. The writer gives formulas for the aerodynamic design of wings to suit various conditions. Disregarding sweepback and sweepforward which are known to have an influence on the stall, his theory assumes that the viscous wake is negligible. It is quite a good approximation of all but "freak" cases, and conforms to all facts sufficiently closely to be useful. *Aeronautics*, April 1941, pages 42–44, 5 illus.

Stodflottorer Nagra Synpunkter pa Sidostabiliseringsanordningar hos Flygbatar (Wing Tip Floats as Lateral Stability Devices for Flying Boats). A study of the history and use of sponson and wing tip floats used on modern seaplanes. The sponsons or sea wings used on the Boeing 314 were first fitted to the Dornier Wal type flying boats built fifteen years ago. In order to overcome the air resistance caused by fixed tip floats, several types of retractable floats have been designed. The structure, application and use of these floats are discussed. *Flygning*, April 1941, pages 11, 12, 2 illus.

Aviation Sketch Book of Design Detail. Perspective drawings and cutaway sketches showing structural details of the landing gear, wings, fuselages, armament and sub-assemblies of American aircraft. Included are details of the Vultee 12 series, an early Model Lockheed Transport, the Boeing 314, the Vought V-143, the Vought-Skorsky VS-310, the Vultee V-120 and the Fleetwing Trainer XBT-12. *Aviation*, May 1941, pages 56, 57, 59, 12 illus.

Designing for Machinability (Part III) Grinding. James E. Thompson. The third in a series on designing parts

for easier production. This installment explains the four principal types of grinders: cylindrical, internal, centerless and surface types. The restrictions on design of ground parts are outlined. *Aero Digest*, May 1941, pages 140, 142, 8 illus.

Heating and Ventilating Systems in Transport Aircraft. Austin Eames Smith. A study of the factors affecting the design of the heating and ventilating systems of air transports from the standpoint of passenger comfort, mechanical operation and production. From the passenger comfort angle the problem differs from the normal heating problem as the heating system has to be designed to operate under extreme ranges and rapid variation in temperature. Humidity must be controlled within such limits as to minimize condensation on windows, windshields and cold metal parts of the airplane structure. The heating and ventilating system must be light and easily serviced, conforming with specifications of both customers and the Civil Aeronautics Administration.

With these facts in mind, the article outlines the approach to designing the heating and ventilating system for a 25-passenger airplane with a supercharged cabin, describing the recirculation, steam heating and temperature-control system applicable to this hypothetical airplane. *Aero Digest*, May 1941, pages 139, 246, 249.

Engines

Engine Design Versus Engine Lubrication. R. J. S. Pigott. A discussion of the increase in severity of conditions for lubrication in the last few years, during which the engine designer has been calling upon the oil chemist for special oils to correct difficulties in operation. The 51 per cent increase in horsepower in ten years is proportioned between increase of compression ratio, intake system, displacement and speed. Increase in severity of mechanical and thermal loadings is due both to increase of rotative speed and brake mean effective pressure. Cooling done by the oil has been increased and pistons are hotter than formerly. Crankcase temperatures have risen.

Compounded oils do not eliminate the basic rate of change of deterioration of oil with temperature. Compounding delays the start of deterioration and lowers the absolute rate.

Too many engineering problems recently have been left to the chemist to solve. Several cases of lubrication difficulty are discussed, and a method of analysis is described which shows accurately what any oiling system will do, and can locate most of the troubles. The general fault nowadays is too low an oil flow over the bearings for cooling and unnecessarily high crankcase temperatures.

Compounded oils are bound to increase in the future, but ultimately each must cover a much wider range of usefulness than any present single oil covers. A short discussion is given to means for increasing brake horsepower without increasing the octane demand of the engine. *S.A.E. Journal*, May 1941, pages 165–176, 7 illus.

Petrol Injection. This editorial comment regarding a recent article, "The Case for the Carburettor" (*Flight*, March 6, 1941; reviewed in *Aeronautical Review*, May 1941), suggests three directions in which direct injection "might score over the carburettor": icing-up, distribution to cylinders and starting the engine. A correspondent's reference to the troubles that may arise when the engine cuts out under negative acceleration is elaborated upon to point out that when the engine cuts out, the propeller goes into fine pitch, and if the pilot does not remember to close his throttle instantly there is a very real danger that when the engine picks up again it will "over-rev" and damage itself. *Flight*, April 3, 1941, page 249; *Aircraft Production*, April 1941, pages 142, 143, 3 illus.

Exhaust Gas Turbo Blowers. Considerable development work is known to be going on in Germany on exhaust gas turbo blowers for supercharging aircraft engines. This summary reviews a brief note on the work of Dr. H. H. Berg of the V.D.I. as published recently in the *V.D.I. Zeitschrift*.

One method of study employed a radiation pyrometer to observe temperatures of certain chosen wheels; in the other Berg used thermocouples applied to the rotating runners for studying the temperature distribution therein. The measuring range for the usual commercial radiation pyrometer does not include temperatures of from 50° to 600°C. (122° to 1112°F.) occurring in the buckets and wheel disks of exhaust gas turbines. A new apparatus developed to fill this gap is described. *Flight*, March 27, 1941, pages 244, 245, 2 illus.

Method of Computing the Dimensions of Airplane Engine Intercoolers. J. Kendall Thornton and Joseph G. Beerer. A theoretical study of heat flow in heat exchangers forms the basis of a rational method of determining the size of an airplane engine air-air intercooler required to satisfy specified design conditions. The theoretical equations are set up so that for any given intercooler type the characteristic coefficients can be found from a limited amount of experimental test data. Then with these coefficients the theoretical equations are made solvable for the three over-all cooler dimensions in terms of allowable pressure drops for engine and cooling air, and heat dissipation required. Test data on a commercially available airplane engine intercooler were analyzed, and the correlation between the theoretical equations with empirical coefficients and the experimental data was within 6 per cent maximum deviation on volume of cooler required for given heat dissipation. *Journal of the Aeronautical Sciences*, May 1941, pages 292–299, 6 illus.

Ein neues Verfahren zur Bestimmung des Gastemperaturverlaufes in Ottomotoren (A New Method to Determine Fluctuations of Gas Temperatures in Otto Engines). H. Graff. Measurement of gas temperature in Otto engines is important as it helps to an understanding of combustion phenomena. Up to now, correct temperature measurements have been possible only by means of the stroboscopical method. Accordingly, the course of combustion was divided into many small sections, and the mean value was taken from as many combustions as possible. However, these methods are not applicable when it comes to phenomena, the course of which is fast and irregular, e.g., engine knock.

This report describes the development of a measuring instrument which gages the temperatures oscillographically, based on the measurement of radiation. The instrument is tested and calibrated by means of an exact stroboscopical method. As compared to oscillographic methods, this new medium has the advantage of synchronizing the oscillogram with temperature fluctuation. *Luftfahrtforschung*, February 1941, pages 8–17, 15 illus.

Some Thoughts on Aero-Motor Problems. J. W. Morrison. A discussion of submerged installation of aircraft engines, beginning with a criticism of the Lycoming O-1230-D horizontally opposed 12-cylinder liquid-cooled engine. The writer claims that, although this 1,200 hp. power plant has fine mechanical characteristics, it is still too deep to be submerged into a high speed bomber's wing. He lists possible methods for reducing this depth, such as the use of direct fuel injection and overhead camshafts.

Answering a suggestion made in a

recent American paper that the four-engined Consolidated B-24 bomber would have the ideal wing for submerged installation of four such power plants in place of the radials now used, the writer contends that a better arrangement would be to use two 2,400 hp. units, as power plants of the present flat design would not enhance the craft's performance and would structurally weaken the wing.

The suggestion that the B-24 be built as a pusher is indicated to be impractical and the writer suggests the designing of a radical type twin-engined pusher type. Suggestions for a 500 m.p.h. bomber, recently made by Noel Pemberton-Billing are also discussed. *The Aeroplane*, April 4, 1941, pages 395–397, 5 illus.

Directory of American Aircraft Engines. Essential data assembled on 19 makes of power plants built in the U.S. The tabulation includes type, performance dimensions, weight, construction, equipment and power output. *Western Flying*, April 1941, pages 147–174, 38 illus.

Modern Aircraft Valves. Part II. A. T. Colwell. The second article in this series on the development of American and European aircraft engine valves presents data on work that has been done toward improving gas flow in the valve ports. The apparatus used for such study is illustrated; its operation and the method of analyzing results are described.

Characteristics and differentiations of Hispano-Suiza, Gnome-Rhone, Rolls-Royce, Bristol, German and Italian valves are discussed, together with variations in design practice particularly as compared to American valve design. A summary section is given to general design principles. *Commercial Aviation*, April 1941, pages 24–28, 52, 22 illus.

The Hispano-Suiza Wind Tunnel. Louis Massuger. Reprint of a summary presented in the *Journal of the Aeronautical Sciences*, September 1940. The original paper was prepared for presentation at the International Congress of the Aeronautical Sciences, scheduled to meet in 1939 but postponed due to the war.

The paper opened with a discussion of recent drag and cooling improvements in both air-cooled and liquid-cooled aircraft engines. The latest cooling versions were described as baffled air-cooled engines enclosed in a N.A.C.A. cowling and the high-coolant temperature, liquid-cooled engine with encased or buried radiator.

The latest Hispano engine at the time of the original paper, an H-type liquid-cooled power plant, was described. This engine used two oppositely-rotating, coaxial propellers, each of which was geared to one half of the total number of cylinders as a complete operating unit which could be stopped at any time without impairing the operation of the other half. An explanation is given of the construction and operation of the Hispano wind tunnel which was capable of testing 1,200 hp. engines at pressures simulating 10,000 meters of altitude and temperatures to −55°C. *Aircraft Production*, April 1941, pages 115–119, 8 illus.

A battery of electrical run-in stands for light airplane engines used by the Lycoming Division of Aviation Manufacturing Corporation at Williamsport, Pa., for the "breaking in" run of 65 and 75 hp. Lycoming engines. Tests indicate that this "cold" run-in for a period of six hours followed by operation at full rated r.p.m. under the engine's own power produces better results than when the engine is operated on the test stand and run-in without outside aid.

Motores Italianos (Italian Engines). In Italy a special study has been made of the manufacture of high-powered air-cooled engines for military airplanes. Although water-cooled 8-cylinder, 10-cylinder and 12-cylinder Vee and double Vee-type engines were used two or three years ago, the present trend is to air-cooled single or double row radial engines or to inverted Vee-type engines. This tendency is due to climatic conditions around the Mediterranean and in North Africa, where it is sometimes difficult to get the proper cooling water.

Information on the Isotta Fraschini "Delta" RC35IDS, the Fiat A82, RC42, and the Piaggio PXIIRC35 are given. *Aeronautica*, December 1940, pages 34, 35, 2 illus.

Analyzing Engine Performance in Flight. R. D. Kelly. United Air Lines recently completed a series of tests on their standard engine equipment to determine how close they were to maximum efficiency and economy. A standard mainliner was equipped with the special Stancal Detonation Units, Torquemeter Nose, Fuel Consumption Meter, eighty thermocouples on cylinder heads, spark plugs and other points as well as the standard instruments.

Results indicated that, while the power plant proved completely reliable, the maximum in efficiency and economy had not as yet been reached. A complete description of the equipment installed is included in an account of the methods and results of the test. *Aero Digest*, May 1941, pages 188, 191, 192, 7 illus.

The Efficiency of Combustion Turbines with Constant-Pressure Combustion. Werner Peining. A translation of an article entitled, "Der Wirkungsgrad von Verbrennungsturbinen mit Gleichdruckverbrennung" which appeared in the September 20, 1940 issue of *Luftfahrtforschung*, reported in *Aeronautical Review*, January 1941, page 13. *N.A.C.A. Technical Memorandum*, No. 975, April 1941, 37 pages, 30 illus.

Oxygen-Boosting of Diesel Engines for Take-Off. P. H. Schweitzer and E. R. Klinge. The results of Pennsylvania State College tests on feeding oxygen into the intake air of a diesel engine show that it increased its power output by 60 per cent without detonation or other ill effects to the engine.

By raising the oxygen concentration of the intake air from the normal 21 per cent to 45 per cent, the brake hp. of the test engine increased from 2.9 to 4.65 hp.; its maximum cylinder

pressure from 700 to 780 lbs. per sq. in. Its maximum rate of pressure rise *decreased* from 88 to 60 lbs. per sq. in. per degree and its ignition lag decreased from 9½ to 5 degrees. Its specific fuel consumption increased 0.43 to 0.59 lb. per hp.-hr. and its exhaust temperature increased from 620 to 1,000°F. under optimum timing conditions and with clear exhaust.

In applying the oxygen boost to airplane diesels for take-off, a 6,000 hp. transport airplane would need about 200 lbs. of liquid oxygen to supply an additional 2,000 hp. for the two minutes required for take-off. *Pennsylvania State College, Engineering Experimental Station, Bulletin Number 54*, April 1, 1941, pages 1–29, 31 illus.

La Turbine Remplacera-t-elle le Moteur à Explosion pour la Propulsion des Avions? (Is the Turbine Going to Replace the Internal Combustion Engine as a Power Plant for Aircraft?) E. J. Sudan. Although great progress has been made in the development of internal combustion engines for aircraft, the limit of their output will be reached at between 3,500 and 4,000 hp., this writer states. He offers proof of the necessity for transforming motion from the alternating rectilinear movement of the pistons into the continuous rotary motion needed by the propeller.

Both the physical and mechanical objections to the present types of power plants are offered. A more efficient form of power, the writer claims, can be derived from steam turbines. As proof, he presents an account of an American experimental steam turbine which he claims showed surprising results in a light airplane. *Schweizer Aero-Revue*, February 1941, pages 11, 12.

Air-Cooled v. Liquid-Cooled Aircraft. Part II. John G. Lee. Conclusion of a paper, the first part of which appeared in *Flight*, March 13, 1941. This portion compares the two types of engines in each of the three main groups—fighters, bombers and flying boats—on a basis of equal size and weight, and concludes that the air-cooled aircraft are superior in the pursuit, bomber and transport types. *Flight*, March 20, 1941, pages 222c–f, 9 illus.; *Journal of the Aeronautical Sciences*, April 1941, pages 219–229, 17 illus. (complete paper).

Il Motore Assiale a Sospensione Cardanica e le Sue Possibilita nei Riguardi della Variabilita del Rapporto di Compressione (The Axial Engine with Cardanic Suspension and Its Possibility in Regard to the Variability of the Compression Ratio). L. Poggi. Description of a new type of crankshaft for axial engines, differing from other types of crankshafts by the manner in which the axial forces are transmitted to the framework.

The new type offers a remarkable advantage from the viewpoint of organic performance. This type of shaft may be used to make possible engines with a variable volume of the combustion chamber. Presented with a brief thermodynamic treatment of the significance of such a solution to aviation generally, especially in view of the additional power required at take-off. *L'Aerotecnica*, February 1941, pages 109–121, 4 illus.

One Engine, One Pump. Note on a recent patent by the German Argus Motoren Gesellschaft for injecting fuel into the supercharger. Instead of the one pump per cylinder used by the designers of other German engines, the plan is to use a single pump delivering a continuous spray into that part of the volute casing of the supercharger at which the cross-sectional area is smallest and where, consequently, the velocity of the air is at a maximum. *Flight*, April 3, 1941, page 260, 1 illus.

Engine Lab. Walter C. Orr. To aid in the development of better power plants for American aircraft, both civil and military, the N.A.C.A. is erecting a new engine testing laboratory on a 200-acre site adjoining Cleveland Municipal Airport. This article describes the buildings, for which ground was recently broken, and outlines the work to be carried on. The reason for the site selected and the neighboring industries which are expected to cooperate with the work of the laboratory are cited. *Flying and Popular Aviation*, May 1941, pages 40, 41, 90, 92, 4 illus.

Fuels and Lubricants

A Method for Measuring Diesel Fuel Ignition Lag. A. E. Traver and W. S. Mount. Where the measurement of ignition lag is principally one of engine design, there is no doubt that the engine indicator drawing a complete curve of combustion cycle is the most direct method for measurement of ignition lag. If, on the other hand, the problem is one of measuring small differences between diesel fuels, an ignition lag meter of some kind is indispensable. This problem is more apparent to petroleum refiners because of the necessity for measuring small changes in ignition quality of fuels. *S.A.E. Journal*, May 1941, pages 177–179, 2 illus.

Development of Aviation Fuels. One of the factors in the increase in power output of the modern airplane engine is the more effective fuel which has been developed since 1929. In a discussion of the part improved fuel has played in power-plant development, this article discusses the introduction and use of octane number as a means of measuring knock tendencies. The rapid strides that fuel development has taken have revealed the limitations of this system. The various methods for testing aircraft fuels from which new scales may be developed are outlined. Present methods for cracking high test fuels and developments which may create higher fuel efficiency and greater fuel safety in the future are explained. *Aero Digest*, May 1941, pages 203, 204, 206, 207, 4 illus.

Flight Testing

"Speedy." C. A. Bell. An account of the power-dive test given the Bell P-39 by Andrew C. McDonough, Eastern Air Lines pilot, who dived the Airacobra to 620 m.p.h. as a spare time activity. The article also describes the armament of the craft, compares it with the airplanes it will have to combat in the European war as to speed, maneuverability and firepower. It also gives a brief personal sketch on the air line captain-test pilot. *Flying and Popular Aviation*, May 1941, pages 25, 72, 74, 76, 2 illus.

Gliding and Soaring

Soaring Flights in Argentina. Alfredo L. Finochetti. Gliding in the Argentine began in 1895 when Pablo Suarez, after corresponding with Otto Lilienthal, built a successful glider at the German pioneer's directions and advice. While the exploits of German gliding overshadowed developments in the Argentine, a fair amount of successful gliding took place and types of native-built craft were constructed in the years following the World War I. In 1930, the Albatross Soaring Club of Argentina was founded and over thirty chapters of the society have been organized since that time.

This article gives a report of soaring conditions in various parts of the country, paying special attention to the *Pampero*, or steady blowing pampas wind. The report also includes a survey of the equipment commonly used by the various soaring groups in Argentina and the launching techniques applied. *Soaring*, February 1941, pages 4–6.

They Soar through the Air. The development of Elmira, N. Y., as the soaring center of the United States is outlined by the general manager of the Elmira Area Soaring Corporation by way of introducing the Twelfth Annual Soaring Contest to be held in Elmira from June 28th to July 13th this year. *National Aeronautics*, May 1941, pages 11 and 55, 3 illus.

What Did Shelly Say to the Duke? Elsie Lee. Shelly Charles, Eastern Air Lines captain, whose hobby is soaring, put on an exhibition of motorless aerobatics at the Miami Air Meet in January. The Duke of Windsor who flew over from the Bahamas for the show was delayed in landing because Charles was in the air. Upon the Duke's request, Charles repeated his aerobatics show in his "Minimoa." This article gives Captain Charles' impressions of the Royal visitor obtained from a brief interview in the Duke's box. *Soaring*, January-February 1941, pages 3, 7, 1 illus.

Glider Troopships. Alexis Dawydoff. Viewing glider troop ships as quite feasible from an engineering standpoint, the writer dramatizes his vision of how such gliders could be built each to carry ten men fully equipped with guns, ammunition and rations for two days and how they could be maneuvered into enemy territory to destroy communications, demoralize the enemy and prepare the way for a planned mass attack. *Air Trails*, May 1941, pages 22, 23, 46, 47, 1 illus.

Record American Distance Flight. John Robinson. An account of the establishment of a new American distance record by the writer on July 13, 1940. In his "Zanonia" soaring glider, he took off from Harris Hill near Elmira, N. Y., during the 11th Annual National Soaring Contest and flew to a spot near Mineral, Virginia, a distance of 290 air line miles. *Soaring*, February 1941, pages 8, 9.

Hochgelegene Aufwindfelder fuer den Segelflug (Regions of Up-Currents in High Altitudes as a Medium for Soaring Flight). H. Externbrink and K. Dreisbach. The German Research Society for Gliding (D.F.S.) has made a series of flights to explore systematically air strata in an altitude above 5,000 meters. The aerological results and several towing tests with gliders showed that sources of energy in higher altitudes may probably be used successfully for soaring. The tests are to be continued. *Schweizer Aero-Revue*, February 1941, pages 22–24, 4 illus.

Vuelo Sin Motor . . . Escula de Vida! (Motorless Flight . . . Schooling for a Lifetime!) A history of gliding from Lilienthal's time to the present, stressing especially the post-war progress of the sport in Germany. Various common methods for launching gliders are described. *Aeronautica*, December 1940, pages 20, 21, 1 illus.

History

Flying as It Was. Hugh A. Robinson. An account of the introduction of the *Curtiss Hydroaeroplane* to Europe in 1912. Four Curtiss float seaplanes were shipped to Hamburg on the S.S. *Amerika*. Before the liner tied up, one of the seaplanes was put over the side and the writer, using the first known mechanical airplane engine starter, took off in the open sea, 25 miles from Hamburg, only to stub the toe of his float in the ice of the river Elbe. The article also contains a narration of early demonstrations at Juan Les Pins in France and an air meet sponsored by the International Sporting Club of Monaco held at Monte Carlo. *Sportsman Pilot*, April 1941, pages 18, 19, 34, 36, 6 illus.

Brewster Aeronautical Corporation. An account of the beginning, development, present and future of Brewster Aeronautical. The descendant of one of America's oldest coach works started business in 1810 in New York. This organization began making fine vehicles when the threatening war of 1812 cut off the imported supply. It has, at various times, built broughams and automobiles, and in 1920 took a small contract for airplane parts.

The aircraft division, a separate company now, has expanded 700 per cent in eighteen months and now occupies two buildings. A third huge factory is under construction. Included in this account are descriptions, history and comments on all types of aircraft built by Brewster, from the first experimental dive bomber to the latest Navy and export fighters. *Aero Digest*, May 1941, pages 79, 80, 83, 84, 9 illus.

The Night Bomber. The evolution in the technique and equipment of night bombing is sketched against a background of the personalities and experiences associated with its development by the British air services.

It goes back to 1913, when night flying depended on the moon, since modern night flying aids were yet unknown. The first attempts to bomb one aircraft from another were carried out at night by naval units in 1915 against three German Zeppelin airships then bombing London. When night bombing was seriously tried the following year, the first show was not very successful, but night bombing practice went on behind the lines and by the end of 1916 it was customary for small numbers of machines to go out on favorable nights to bomb airdromes, railways, dumps and similar targets.

By April 1917, the employment of bombing airplanes as an independent force was begun and one Flying Corps squadron was detailed for special night bombing duties, using F.E.2b airplanes, the standard medium bombers of the first World War; another squadron used the B.E.2e. Naval units were then using Short seaplanes, with loads varying from one 520-lb. to eight 65-lb. bombs.

The first multi-engined airplanes came into night bombing use in April 1917, with the introduction of the Handley Page twin-motored 0/400, which was of greater power than the Short and carried fourteen 112-lb. bombs, or one 1,650-lb. bomb for special targets. The 0/400 became the standard heavy bomber of the war. Indiscriminate bombing of London in 1918 is said to have led to the British plan to use the V/1500 Super Handley Page, for which bombs weighing 3,300 lbs. were made, and which had a crew of six and could carry 30, 250-lb. bombs. But only three of these aircraft were ready by the end of the war.

Only four new types of bombers came out of the early years after the war, "owing to the financial recuperation which took effect until rearming was badly overdue." These were the Vickers Vimy, which was just going into production at the end of the war, the Virginia and the Handley Page Hinaidi and Hyderabad.

1927 is said to have marked the first real advance in night bomber design with the production of the Handley Page Heyford, last of the biplanes, and the Fairey Hendon, the first monoplane to go into R.A.F. service for many years. In 1935 the policy of classifying as day and night bombers was changed to a designation of light, medium and heavy bombers, any of which might be used at night.

Before the arrival of the modern metal types with retractable undercarriages, such as the Blenheim, Hampden, Wellington and Whitley, there came an interim heavy bomber, the Handley Page Harrow. A large proportion of these are still in use for training. Coming right up to date there are now on operational duties the twin-engined Avro Manchester, the four-engined Short Stirling and the Handley Page Halifax. *Flight*, March 27, 1941, pages 238a–g, 25 illus.

DVL. R. S. Saville-Sneath. The history of the *Deutsche Versuchansstalt für Luftfahrt* at Adlershof outside Berlin. This major German research station was founded 25 years ago by a group of early aeronautical scientists with the financial aid of the Prussian government. Contrary to general impression, DVL does not function solely for the German government but does outside testing for private concerns and even sells to both German

and foreign trade the testing instruments which it has developed.

Some of the basic testing instruments are described, among them the diamond scratch recording system for recording movements down to 0.1 mm. This instrument permits greater compactness for all recording instruments. On a glass drum 25 × 12 mm., it can make a record covering 25 hours; on ordinary paper the same record would require a strip a quarter of a mile long. Particulars are also given on fatigue testing machines, optographs, aerodynamic and flight mechanics testing devices, instruments for recording opening shock of parachutes, torsiographs and similar devices. *Aeronautics*, April 1941, pages 56–59, 11 illus.

Instruction

High Speed Acrobatic Maneuvers. Cloyd P. Clevenger. A study of correct methods for performing high speed aerobatics such as pull-ups and pull-outs, Chandelles, etc., in such a manner as to impose a minimum strain on both the airplane and the pilot. Common errors in the performance of these maneuvers are analyzed and methods for correcting them are recommended. *Aero Digest*, May 1941, pages 76, 213, 1 illus.

Flight Test Your Own Airplane. Part III. Brian Sparks. The third in a series on determining characteristics of aircraft, written for the private pilot. This installment describes a method for calculating the maximum rate of climb, maximum angle of climb and their application to safety in actual flying. *Sportsman Pilot*, April 1941, pages 30, 32, 34. 3 illus.

A Large-Scale Program for Training Shop Personnel. Bartley Whiteside. Faced with the problem of providing competent men for their suddenly increased plant capacity, Wright Aeronautical Corporation abandoned the accepted method of advertising for help and waiting for men to apply. Skilled labor from other industries had proved unsuitable. It appeared that the best solution was to get "green" men and train them from the start, applying an engineering approach to the problem of mass education.

The cost of setting up a separate school with full-time instructors was prohibitive. The procedure finally adopted resulted from a series of conferences with supervisors and foremen. From these, the most efficient method of imparting the "how" of machine operation to the learners was determined. To provide selection and a proper background, students were given a four weeks' night course at the Paterson Vocational High School in related technical subjects. This educational period gave the company an opportunity to gage the aptitude of the student.

When defense orders put increasing pressure on the plant, a program was adopted to put men into specialized jobs and educate them to top efficiency on a single machine. This was accomplished by placing the trainee next to a skilled worker on a similar machine, permitting him to absorb the technique by observation as well as practice and instruction. *Aero Digest*, May 1941, pages 60, 62, 167, 7 illus.

Acrobatics Are Easy. Part II. Daniel J. Brimm, Jr. Continuing his series on aerobatics, the writer discusses the flight principles underlying the looping of an airplane. A description is given of the maneuvers involved in a loop with a quarter-roll recovery, the Cuban eight loop, the slow roll, the inverted spin and the exercise of inverted coordination. *Aviation*, May 1941, pages 34, 35, 150, 152, 154, 4 illus.

The Army Wants Them Smart. Major Roland Birnn. In the pamphlet issued by the U.S. Army Air Corps on the requirements for acceptance as cadets, many young men question just what is meant by the educational prerequisite of two years of college or "a written examination in lieu thereof." The writer, not considering himself a fair judge of the adequacy of this requirement, selected a typical high school graduate and measured his education against the Air Corps requirements.

The student achieved a passing grade. Parts of the examinations in English and Composition, American and General History, Geography, Physics, Geometry, Algebra and Trigonometry are given. Recommended books are listed for those who want to "brush up" on these subjects in order to pass the qualifying examination. *Flying and Popular Aviation*, May 1941, pages 32–34, 86, 88, 5 illus.

Night Solo. Lieut. Frank R. Pancake. An Army pilot's description of his first solo flight at night while a cadet at Randolph Field. *Flying and Popular Aviation*, May 1941, pages 48, 49, 92, 3 illus.

R.A.F. Operational Training. A picture survey of the R.A.F.'s course in operational training. It includes such subjects as traffic control, signaling, navigation, gunnery, long-range bombing and instrument flying. *Aeronautics*, April 1941, pages 62, 63, 8 illus.

Pilots Coming Up. Virginia Withington. A comprehensive survey on the nature of the expanded training program for pilots, crews and ground personnel for the Army Air Corps. The expansion of existing facilities at established bases and the building of new training centers are making possible the instruction of the 16,000 pilots and 160,000 non-pilot staff which the expanded production program will demand. How, where and how much of this program is taking place at various locations, the trend in equipment and a comparison of the U.S. training program with that of the German *Luftwaffe* are noted. *Flying and Popular Aviation*, May 1941, pages 37, 38, 84, 86, 2 illus.

Beware the Quickie Course! John Du Barry and Alexis Dawydoff. The increase in aircraft production created a heavy demand for trained labor. Many inferior trade schools sprang up, promising quick, cheap training, taking money from ambitious young men and sending them out unfit to hold jobs in aircraft factories. This article is a warning to young men who are about to invest money in ground training. It tells them what to look for in the school they select and how to differentiate between the schools which will train them properly and those which will not.

The general rules for judging schools, the minimum length of courses, the equipment contained and the qualifications of their instructors are outlined. The article also includes a list of government approved institutions. *Air Trails*, March 1941, pages 16, 17, 49–51, 6 illus.

The A.T.C. Has "Taken Off." Pictures and captions depicting the Air Training Corps training of potential airmen in some 1,000 university, college, school and local squadrons of English youth. Evening classes, practical and theoretical, are designed to give them a useful groundwork for flying when they join the R.A.F. or Fleet Air Arm later. *Flight*, March 20, 1941, page 222b, 5 illus.

Instruments

A New Boost Gauge for Aircraft. A treatise on the use, theory, construction and maintenance of the "Boost" or "Supercharger Gauge," as the British call their instrument for measuring manifold pressure. *Aeronautics*, April 1941, pages 64, 65, 1 illus.

Details of a German Bomb Sight. Drawings by G. H. Davis of the *Illustrated London News*, prepared on the basis of data from official sources. The Lofte 7B, standard German bomb

sight, is shown in side and sectional views; another sequence of illustrations portrays the method of using the bomb sight as installed in the nose of a Heinkel bomber. *Scientific American*, May 1941, pages 261, 262, 12 illus.

Some Hints on Servicing Aircraft Instruments. J. G. Frey. Useful information on instrument trouble-shooting for field service mechanics. Common failures in ordinary flight instruments are diagnosed, giving particular attention to magnetic and electrical interference with the compass. *Canadian Aviation*, April 1941, pages 39, 40, 4 illus.

Maintenance

Uncle Sam's Thunderbird Nest. James P. Eames. An account of a visit to the Army Air Corps' repair and supply depot at Sacramento, where the writer watched Army airplanes, engines, propellers, accessories and parachutes major-overhauled by skilled Air Corps technicians.

The procedure for tearing down, cleaning, inspecting, adjusting and reassembling service aircraft is described. *Air Trails*, March 1941, pages 14, 15, 56–58, 7 illus.

Repairs to Service Aircraft. Gordon H. G. Garbett. Trainers need the most repair work, particularly as a result of heavy landings, which often break the radius rod of the undercarriage, and as a result of landing on the nose of the airplane, which usually damages the nose fairing or the front fuselage where the nose fairing is an integral part of the front fuselage.

The chief points and processes for fuselage repair are outlined as they apply to negligible damage, reparable damage and damage that calls for replacement. The success or failure of fuselage repair work depends on the riveting, the importance of which is explained. Repair of more typical damage to wings, spars, fuel and oil systems and the engine nacelles is described in brief. The procedure outlined in this article applies only to metal aircraft, as a different technique is used in repairing wooden aircraft. *The Aeroplane*, March 28, 1941, pages 370–372, 9 illus.

Manufacture

Labour under War Conditions. B. C. Jenkins. An abstract of a paper presented before the British Institute of Production Engineers on the utilization and training of female and semi-skilled workers for wartime production. The writer points out that, during peacetime production, labor was trained to do a specific job. Due to the decay of trade apprenticeship, the supply of trained labor has become limited and production has to be planned to conform with the labor supply available.

To achieve a maximum of efficiency, work must be analyzed with great care: distributing rough work to unskilled labor, repetitious tasks to women where physically suited, and sparing skilled craftsmen for the important work. Plans are explained for the promotion of students and workers after shorter training periods. *Aircraft Production*, April 1941, page 119.

Streamline Production Speeds Output of Warplanes. Andrew R. Boone. Adopting methods devised originally by automobile manufacturers, Douglas Aircraft Company has eliminated waste time, motion and material by abolishing certain departments and placing the assembly line on a progressive basis. The revamping of assembly system, worked out by T. B. Coulter and Tom Brennen, reduces assembly time by over 66⅔ per cent. Changes in factory layout and new machines and methods applied to achieve this acceleration are described. *U.S. Air Services*, April 1941, page 19.

Templates in Five Minutes. A new aid to accelerating aircraft production has been developed by Clarence O. Prest of Lockheed and placed at the disposal of the industry. It makes possible the reproduction of a template drawing in five minutes. Based on the principle of electrolytic transfer, the process contains only three simple steps. Once set up it can be operated by ordinary factory personnel. The steps consist of making the master drawing, scribing it onto a specially treated metal plate and then, electrolytically transferring the drawing onto inexpensive metal plates from which templates are cut. *Western Flying*, April 1941, pages 176, 177, 3 illus.

Control of Planned Production. Bruce Foster. The last in a series of three articles on production details at the Rootes Airframe Factory, now engaged in building Bristol Blenheim bombers. This installment explains the method applied here for planning work in such a manner as to have the proper material ordered and delivered at the point where the component is being built and the completed component at its place on the assembly line, ready to be fitted onto the finished airplane.

This calls for the creation of a time-cycle chart which indicates the time required for the building of each part in relation to the fly-away time set for a particular airplane. The program for the entire plant is laid out on a "target date" chart which indicates the output of the plant in parts and completed aircraft, showing the number of parts that must be completed on a set date to meet their need for use in future completed craft. By using this system, production can be uniformly controlled and accelerated with a minimum of time loss due to shortage of materials or piling up of unused parts at the assembly line. *Aircraft Production*, April 1941, pages 120–123, 4 illus.

Milling Cutters. A report on the investigations made to determine the effect of the tooth helix angle on the surface finish and cutting capacity of milling cutters. *Aircraft Production*, April 1941, page 123.

The Hawker Hurricane. Wilfred E. Goff. A study of the development, evolution and production of the stressed-skin metal wing of the Hawker Hurricane. This wing originally was fabric-covered and stood up in service surprisingly well, despite doubts entertained in many quarters concerning the material's ability to stand up at speeds in excess of 350 m.p.h. Developments on the Hurricane included propeller changes, alterations in exhaust systems and, finally, all-metal stressed-skin wings. These proved to be 35 lbs. lighter than their fabric-covered predecessors.

The article contains a complete technical description of the structure of the new type wing, explaining the application of modern high-speed tools to its construction. The assembly of the wing components and the installation of gun mounts and covering are also outlined. *Aircraft Production*, April 1941, pages 126–134, 26 illus.

North American Dedicates Dallas Plant. On April 7th, North American Aviation, Inc.'s windowless, million-square-foot factory at Dallas, Texas, was dedicated just a little more than four months after construction began. The ultimate staff is expected to reach 12,000 workers, making possible a production rate considerably in excess of ten trainers a day, AT-6A for the Army and SNJ-3 for the Navy. Physical characteristics of the new plant and its relationship to the parent company are described. *Aviation*, May 1941, pages 36, 37, 162, 3 illus.

Machining Problems in Aircraft Construction. J. P. Johnson. Good machinability begins with the engi-

neering department. The purchasing of greater quantities of aircraft units has made it possible to design aircraft suited to quantity production. This in turn has eliminated many difficult machining problems, and has permitted the development of much better jigs, fixtures and special tools for intricate as well as standard parts.

New men must become familiar with certain principles of aircraft production which differ from other types of machine-shop practice. Honesty about scrapped work is essential. All employees should be taught the seriousness of allowing a bad piece of work to get into the mechanism of an airplane. Cleanliness and proper care of the entire plant, the machinery, tools and the persons should be emphasized. The problem of recruitment of new workers is discussed in the light of the skilled labor shortage now facing the aircraft industry. *Mechanical Engineering*, May 1941, pages 346, 356.

Production of the Bell P-39 "Airacobra." A picture survey of the construction of the Bell Airacobra, known in England as the Caribou. The views permit inspection of the method used in wing and fuselage construction, showing how the sub-assemblies are built and put together to make complete components. *Aero Digest*, May 1941, pages 72, 75, 11 illus.

Changing Tool Holders Instead of Tools. J. R. Longwell. A suggestion for saving time in machine production by changing tool holders instead of the tools themselves. The higher relative proportion of unskilled men operating machines over skilled tool setters often leaves machines idle, waiting for the toolsetter's service. Examples of rapidly changeable tool holders, their structure and use are explained in this article. *Aero Digest*, May 1941, pages 209, 210, 5 illus.

Tube Grinding and Polishing. A description of the Mattison special-purpose grinding machine designed to facilitate the grinding and polishing of the internal walls of long tubes. This is accomplished by means of an endless abrasive belt traveling longitudinally through the rotating tube and pressed against the walls by means of a head expanded by compressed air. *Aircraft Production*, April 1941, page 134, 2 illus.

Aircraft Forgings in a Canadian Plant. J. E. Gammage. Pre-war production of aircraft forgings in Canada was negligible, but when England became shut off as a source the overnight demand for larger Canadian operations in this field brought into play the pioneering work and large investment already laid out by Hayes Steel Products Limited. This company is now turning out thousands of parts daily in a new and self-contained division for the aircraft industry. Facilities and operations of the division are described. *Commercial Aviation*, April 1941, pages 56, 58, 62, 11 illus.

Das Taktverfahren, die Fabrikationsmethode, im Modernen Flugzeugbau (Mass Production, the Manufacturing Method in modern Airplane Construction). A pictorial review of modern manufacturing methods at the Heinkel works, depicting the construction of the He 111 bomber. *Der Deutsche Sportflieger*, March 1941, pages 52–54, 8 illus.

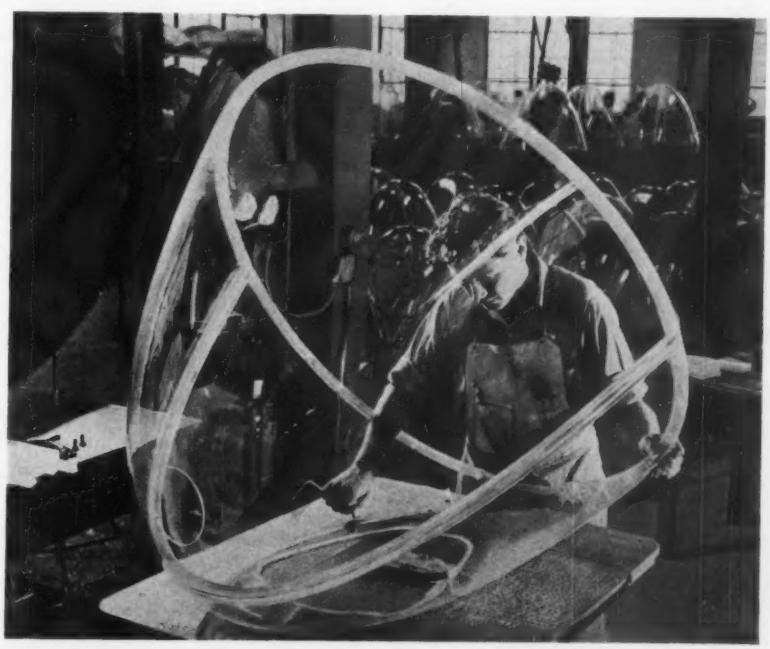
Materials

What about Plastic Airplanes? Sherman M. Fairchild. The possible shortage of light alloys has again focused attention on plastics as an aircraft material, recalling the popular and all-too-rosy promises made by certain plastics experts a few years back. Many of those who discussed the almost miraculous properties of plastics failed to appreciate the complexity of aircraft material requirements. The industry soon discovered that there was no cure-all for its problems—that the way to success was by painstaking research engineering.

The article outlines the work of the Fairchild Company in developing the Duramold process, one of the earliest applications of plasticized wood in aircraft construction. The problems which prompted the experiments, some of the obstacles encountered and the results obtained thus far are outlined. The use of plastics in aircraft has progressed to the point where the N.A.C.A. has instructed its structures committee to begin studies which will give the industry generic formulas to aid further research in the field. *Aero Digest*, May 1941, pages 132, 133, 250, 1 illus.

Fybr-Tech, a New Material for Airplane Construction. J. R. Fitzpatrick. Fybr-Tech, a new material for aircraft building, consists of a veneer core with a sheet of vulcanized fiber resin-bonded to each face. It can be sawed, drilled, die-punched and sanded without serious risk of splitting. It can be bent or molded with a fraction of the pre-treatment necessary for conventional plywood. Figures on the strength of the material and suggestions for its use, both in airplane structures and interiors, are given. *Aero Digest*, May 1941, pages 175, 176, 4 illus.

Forming and Mounting of Acrylic Plastics. D. S. Frederick. A study of the molding and installation of Plexiglas, a transparent acrylic plastic



Formed halves of a *Plexiglas* bomber nose are cemented together with acrylic resin, the same material from which the components are molded. The workman is trimming the edge of a bombardier's door and the gun mount hole so that the necessary hardware can be installed.

commonly used in aircraft windshields, windows and similar installations. This material can be formed at temperatures between 220° and 250°F. over wood, plaster or metal patterns. The methods for drilling, finishing and installing Plexiglas units of various shapes are outlined. *Aero Digest*, May 1941, pages 195, 196, 9 illus.; *Aviation*, Plexiglas Eyes for Bombers, pages 42, 43, 7 illus.

Molding Plastics. Robert Decat. A discussion of molding methods being used in airplanes and accessories. Touching on the plastics most suitable to aircraft structures, a description is given of various methods in use in this country for the molding of plastics reinforced with wood and with fabric. *Aviation*, May 1941, pages 40, 41, 126, 128, 5 illus.

Plastics in Aircraft. J. Earl Simonds. This article is the first in a series of three intended to provide a basic understanding of the materials and uses of plastics in aviation today. A discussion is given of the application of plastics to aircraft propellers, interiors and structural members. The inherent properties peculiar to certain types of plastic materials are described in relation to their influence upon the choice of materials used. *Aviation*, May 1941, pages 38, 39, 124, 128, 6 illus.

Kriechverhalten geschichteter Kunstharzpresstoffe (Creep Conditions of Laminated Plastics.) H. Perkhuhn. Static load tests have been made on a series of laminated plastics which had a varying resin content and were subjected to various compressions, to determine the dependence of fractural stress on time, covering a period of about 30 days.

Creep conditions, and fatigue strength at room temperature and 75% of relative humidity were also investigated. Stress which causes fracture within 30 days is, as an average, 50 to 75 per cent of the maximum stress reached during a tensile strength test at a load velocity of 800 kg./cm.^{2}/min. Fatigue strength has been determined to be about 28 per cent of this tensile strength. *Luftfahrtforschung*, February 1941, pages 32–37, 23 illus.

X-Ray Measurement of Internal Screw Threads. Robert C. Woods and E. Keith Hight. Description of a method for measuring internal screw threads by means of radiographs, a technique developed by the Bell Aircraft laboratories. The type of projector, the radiographic and developing technique and the method of interpreting the radiograph are explained. *Aero Digest*, May 1941, pages 199, 200, 6 illus.

Medicine

Test Tube Aces. James Montagnes. Candidates for the Royal Canadian Air Force undergo a rigid physical examination at the Initial Training School at Toronto. It is conducted by specially trained physicians who have made detailed studies of the exacting physical demands of modern combat flying on the bodies of the active military pilots.

To eliminate the physically unfit, special testing machines are used, such as the electrocardiogram which records the heart action and the electroencephalograph which checks the brain waves. The lung capacity and breathing habits are recorded by the spirometer, while the candidate's reaction to altitude changes are observed in the decompression tank. How these new tests are used in combination with the old ones in determining the fitness of the individual cadet for flying duty is described. *Flying and Popular Aviation*, May 1941, pages 28–30, 103, 7 illus.

Civil Aeronautics Medical Forum. W. R. Stovall, M.D. This transcript of the proceedings of the Civil Aeronautics Medical Forum at the 1940 Annual Meeting of the Aero Medical Association of the U.S. contains a full record of the discussion, questions and answers, and broaches a wide variety of problems significant to this branch of aviation medicine. *The Journal of Aviation Medicine*, March 1941, pages 72–87.

Recent Trends in Aviation Medicine. Capt. John R. Poppen. Sketching contributions to aeronautical medicine by World War experience and the developments growing out of that experience, the writer poses major problems facing this branch of medicine today, viewed in the light of past research and new needs. Advances in aircraft design and performance are explained to show how they exceed the adaptive capabilities of the average normal human being. Among such advances, the increased speed and rate of climb, higher altitude flying and the great complexity of instruments and accessories requiring the pilot's attention are discussed in relation to their effects upon flyers.

Analyzing the trends in aeronautical medicine resulting from these new demands on the individual's adaptive capabilities, particular attention is given to: the selection of flying personnel, protection against the effects of high acceleration, oxygen supply for high-altitude flying, protection against aero-embolism, instruments and accessories simplification, visual problems and fatigue. The task of aviation medicine is now to prepare pilots not only to get the most out of their aircraft, as during the first World War, but in addition to prepare them to get the most out of themselves. *The Journal of Aviation Medicine*, March 1941, pages 53–71.

Medical Problems in Flying. Relating to new medical problems resulting from higher, faster flight and increased night flying, certain paragraphs are reprinted from the January issue of *Bulletin of War Medicine*, a collection of extracts.

The first, on the subject of blackout, is taken from "Preventive Medicine in Relation to Aviation," the presidential address given by Air Vice-Marshal H. E. Whittingham before the Royal Society of Medicine in 1939. The second, on the loss of oxygen at great height, is from a paper by W. M. Boothby, O. O. Benson, Jr., and W. R. Lovelace entitled "Emergency Oxygen Unit for Use in Parachute Escape or in Case of Failure of Regular Oxygen Supply at High Altitude," published in the *Journal of Aviation Medicine* for June 1940.

The third, on night vision, comes from an article by C. E. Ferree and G. Rand, published in *Science*, 1939. The last, on centrifugal forces, is from a paper read at a staff meeting of the Mayo Clinic in September 1939 by R. B. Phillips and C. Sheard, entitled "Amaurosis fugax: Effect of Centrifugal Force in Flying." *The Aeroplane*, March 28, 1941, pages 366, 367, 4 illus.

Combined Electrocardiography, Stethography and Cardioscopy in the Selection of Pilots. Walter M. Bartlett, M.D., and J. Bailey Carter, M.D. This paper, read before the 1940 Annual Meeting of the Aero Medical Association of the U.S., is accompanied by a transcript of the discussion which followed at the meeting. In describing the use of combined electrocardiography, stethography and cardioscopy in the detection of heart disease, the writers stress the history of developments in this field of medicine and discuss their importance. Ten case reports are presented to emphasize the clinical value of the combined examination for the evaluation of cardiovascular function.

Concluding with the assertion that routine examination is inadequate for detecting early cases of heart disease, it is said that this combined examination is a "useful, practical, precise and

economical adjunct to the routine examination of applicants for flight training"—the cardioscope for speedy diagnosis, the stethogram for accuracy of heart sound interpretation and the electrocardiogram for the determination of myocardial integrity. *The Journal of Aviation Medicine*, March 1941, pages 2–29, 10 illus. and bibliography.

A Mask Apparatus Which Provides High Oxygen Concentrations with Accurate Control of the Percentage of Oxygen in the Inspired Air and without Accumulation of Carbon Dioxide. Alvan L. Barach, M.D., and Morris Eckman. An oxygen mask apparatus is described in which an air injector is utilized to provide known and accurately controlled percentages of oxygen in the inspired air, from that set on the dial of the apparatus. The investigation reported here indicates that the apparatus is suitable for use in clinical oxygen therapy and also in commercial and military aviation, at altitudes between 10,000 and 33,000 ft.

Comparing the apparatus with previous developments in this field, its advantages are stressed as being: the elimination of rebreathing; lack of resistance to breathing revealed during quiet respiration; deep breathing with comfort made possible; and its economic use of oxygen. *The Journal of Aviation Medicine*, March 1941, pages 39–52, 3 illus. and bibliog.

The Effect of Low and High Oxygen Tensions on Mental Functioning. Alvan L. Barach, M.D. According to this report, variations in the oxygen concentration of the inspired air beyond that to which the individual has become accustomed result in characteristic changes in mental functioning. Recent studies are said to have shown that impairment of reason, memory and judgment takes place at altitudes as low as 12,000 ft. Notes are recorded on the observation of both normal and psychoneurotic subjects who breathed an atmosphere of 13 per cent oxygen (equivalent to an altitude of 12,400 ft.) for three hours.

While inhalation of high oxygen atmospheres has not been found to produce any alteration of mental function in normal subjects, it is said that the inhalation of 50 per cent oxygen in patients with a previously existing chronic naoxia (oxygen-want) may temporarily produce a profound disturbance in mental functioning, especially in cases of pulmonary emphysema and pulmonary fibrosis in which the arterial oxygen saturation has been lowered over a long period of time.

The discussion ensuing the presentation of this paper at the 1940 Annual Meeting of the Aero Medical Association of the U.S. accompanies the article. *The Journal of Aviation Medicine*, March 1941, pages 30–38 and bibliography.

Supercharging the Pilot. Alexander Klemin. Extra high speed and high altitude flying necessitate supercharging the pilot when flying airplanes the cabins of which cannot be supercharged because of weight and performance requirements. The Lockheed Company has been experimenting with supercharging a test pilot, using a simple process developed originally by the Mayo Clinic.

Before a high altitude flight, the pilot exercises in a decompressor room: dons inhalation apparatus, turns the valve to start the flow of oxygen and for 30 minutes pedals a stationary bicycle at a pace equivalent to walking at the rate of $2^1/_2$ m.p.h. While still in the decompressor room, he must put on his flying suit and switch to a small portable oxygen flask which is carried to the plane, where he connects his inhalation apparatus to the plane's oxygen tanks. Examination of the pilot before and after rapid flights to well above 30,000 ft. prove the supercharging by this method to be entirely successful. *Scientific American*, May 1941, pages 302, 303, 2 illus.

Iets over Geluid en Geluiddemping (Data on Sound and Sound Damping). Sound waves which may be perceived by the human ear have a wide frequency range. The extreme limits may be considered to be 20 Hz and 20,000 Hz (1 Hz = 1 vibration per second). As the highest auditory limit varies considerably, it decreases with the age of the individual to about 12,000 to 15,000 Hz. This article treats scientificially sound and sound damping, as applied to airplanes. It describes sound proofing methods, insulation materials and measuring instruments. *Luchtvaart*, March 4, 1941, pages 90–92, 2 illus., and March 18, 1941, pages 106–109, 4 illus.

Metallurgy

Surface Finish. A study of the effect of various abrading operations on the metallurgical construction of the surfaces of finished steel parts, beginning with an examination of the construction of surfaces finished by various methods. The Profilometer, an electrical instrument used to measure projections and indentations varying in height from less than a millionth to one thousandth of an inch is described. Its use for measuring the smoothness of finished surfaces is explained. The various abrading processes, grinding, lapping, honing and superfinishing, are presented and compared. *Aircraft Production*, April 1941, pages 144–148, 16 illus.

Über aushartbare Aluminium-Zink-Magnesium Knetlegierungen (On Hardening Malleable Aluminium-Zinc-Magnesium Alloys). W. Bungardt and G. Schaitberger. Report on strength characteristics, corrosion strength and stress corrosion properties of some hardening malleable aluminium-zinc-magnesium alloys, to which vanadium and copper were added. These alloys have been quenched at 450°C. in water, and stored at room temperature. *Luftfahrtforschung*, February 1941, pages 26–31, 13 illus.

Investigation on the Mechanism of the Cementation of Metals. Late Masaji Goto, Mirosi Asada and Tuneyosi Okamoto. This study of the mechanism of cementation is intended to furnish guidance for the coating of metals when the vapor pressure of the material to be coated is far greater than that of the coating metal, as in the case of applying molybdenum to nickel.

In the experiment described, round bars of nickel surrounded by molybdenum powder were cemented under various conditions of heating temperature, heating period, heat treatment after cementation, diffusion agent, etc., but adequate cementation could not be effected. Microscopic examination and X-ray analysis of test results for study of the mechanism of cementation led to the development of a two-stage heating process by means of which it is possible to effect adequate cementation. The concentration of the molybdenum of the cementation coating was determined by X-ray analysis and its density was examined by means of hydrochloric acid corrosion.

The two-stage heating process is a method by which cementation is carried on for several hours at a temperature below the critical temperature (for example at 1100°C.), and then carried on again above the critical temperature. X-ray examination of specimens thus treated reveals pure molybdenum on the surface and molybdenum penetration to a depth of 0.22 mm. Thus perfect cementation can be effected, according to the writers, who conclude that metals with a low vapor pressure can be satisfactorily cemented upon metals

with higher vapor pressures by this process. *Report of the Aeronautical Research Institute, Tokyo Imperial University*, No. 200, October 1940, pages 429–476, 39 illus.

On the Mechanism of a New Transformation and Some Associated New Reactions in the Iron-Nickel-Aluminium System. Syûiti Kiuti. Discussing the results of X-ray studies of iron-nickel-aluminium alloys in various stages of annealing up to 3,500 hours at 1,000°, the writer explains his finding of a new change, $x \rightarrow x + x'$, taken as the main reaction in the ternary system, instead of the $x \rightarrow x + y$ change as suggested by previous investigators. The new x'-phase is identified as the solid solution of the intermetallic compound NiAl.

Study of the ternary equilibria by means of X-ray analysis resulted in the finding of new phase boundaries and associated reactions which were confirmed by dilatometric analysis. From the new ternary equilibria the conode-line in the iron-nickel-aluminium magnet alloys was determined and the mechanism of the splitting phenomenon of x-crystals due to the new transformation was thus clarified. *Report of the Aeronautical Research Institute, Tokyo Imperial University*, No. 203, December 1940, pages 591–720, 95 illus.

Hautpflege bei Metallflugzeugen; die Elektrische Oxydation und Ihre Vorteile (Surface Treatment on Metal Airplanes; Electric Oxidation and Its Advantages). H. Otto. Among the various surface treatments in airplane construction, the electric oxidation of aluminum and its alloys (known in Germany under the copyrighted name *Eloxal*) stands out in front.

This article describes the direct current-sulphuric acid method and the direct current-oxalic acid method; pretreatment; fixing devices; immersion of the parts into the eloxal bath; closing the pores in a hot solution of bichromate of potassium; coloring; electric breakdown strength of the oxide layer; heat resistance of the oxide layer; cost of the eloxal method. *Der Deutsche Sportflieger*, March 1941, pages 56–58, 10 illus.

Meteorology

The Relation of Isallobaric Wind Components to the Change of Pressures over a Given Locality. I. Gringorten. Why cyclones deepen and fill up is one of the fundamental problems in meterology that still largely resists theorotical treatment; but it is a matter of great practical importance because it does not seem that our daily forecasts will improve greatly until we find quantitative expressions for the factors leading to development as well as mere translation of pressure systems.

In this paper the writer follows up a line of attack already laid down by several European investigators to see how well it may agree with reality. While he does not offer us a new principle the result is very interesting because he shows that the familiar conception of the isallobaric wind component, *i.e.*, the small departure of the wind from the "gradient wind" which follows the isobars (except with surface friction), must play an important role in the pressure changes observed on the weather maps or the barograms every day. Qualitatively this has been believed for some time but Mr. Gringorten has computed the expected pressure change, from formulas proposed by Bjerknes and by Sutcliffe, for a particular time and place.

This case was for the layers between 2,000 and 8,000 ft. above Detroit between 7:30 p.m. February 2 and 7:30 p.m. February 3, 1940. The computed pressure change at 2,000 ft. was at the rate of 22.8 millibars in 12 hours but the observed change was only 5 millibars. The practical meteorologists will not regard this as very good agreement but in view of the great difficulties in the theoretical treatment of such a problem the theoretician finds some consolation in that at least the computation gives results in the right direction. The writer points out that it was obvious on February 3rd from the a.m. weather map that the pressure would fall at Detroit by that evening, and no one would suggest that the theory be used for forecasting. *Bulletin of the American Meteorological Society*, March 1941, pages 117–120.

Examples and Outline of Certain Modifications in Upper-Air Analysis. R. B. Montgomery and Athelstan F. Spilhaus. The first part of this paper deals with methods of isentropic analysis based on the scaled values of data transmitted for the purpose by the United States Weather Bureau. The practical application of shear-stability ratio vectors is demonstrated. A logical order of analysis is presented, designed to make the fullest possible use of all data available. The preferred isopleths for direct representation are those of temperature, acceleration potential and specific humidity; a system of isopleth spacing convenient in conjunction with surface weather maps is employed.

In the second part the properties of various surfaces for upper air analysis are systematically studied. It is found that severe restrictions exist in the use of surfaces of constant entropy or potential temperature. All the properties discussed are, however, adequately satisfied by a surface of constant potential virtual temperature, a quantity newly introduced and defined as the potential temperature of matter of standard composition, in this case dry air, at the same pressure and density as the sample. The thermodynamic configuration of this surface is described by isotherms of virtual temperature. *Journal of the Aeronautical Sciences*, May 1941, pages 276–283, 1 illus.

A Comparative Study of Fog and Low Ceilings at Portland, Ore. (Swan Is.) Airport and the New Portland-Columbia Airport. Philip Williams, Jr. The present Portland airport located on Swan Island in the Willamette River is to be moved in the near future to the larger and more spacious Portland-Columbia Airport on the Columbia River. Since terminal forecasts will soon be made for this new airport, comparative weather conditions, especially fog, are of interest.

In the study, Portland-Columbia was found to have 31 per cent more hours per year with visibility equal to or less than $^1/_2$ mile, and also slightly more hours with ceilings equal to or less than 600 ft. This makes Portland-Columbia somewhat less favorable for air line operations. Portland-Columbia also has 23 per cent more days per year, on the average, with visibility equal to or less than $^1/_2$ mile and/or ceilings equal to or less than 600 ft. However, the strong easterly winds of the Columbia River Gorge are a factor which frequently keep Portland-Columbia relatively fog free while Swan Island has dense fog.

Portland-Columbia airport has the advantage of being so located as to have considerably less city smoke, and because of this, less hours of instrument weather. *Bulletin of the American Meteorological Society*, March 1941, pages 109–112, 3 illus.

Isolation and the Prediction of Maximum Temperatures. M. Neiburger. The amount of energy required to change the lapse rate of an atmospheric layer from one value to another is given by $Q = (\gamma_2 - \gamma_1)Q_I$ where $Q_I = C_P \rho_m Z_0^2/2$ is the energy required to change the layer of thickness Z^0 and mean density ρ_m from isothermal to dry adiabatic conditions. The height to which a given amount of effective insolation will establish an adiabatic lapse rate may

be found by means of this formula, given the temperature-height curve in the early morning; from this the expected maximum temperature may be evaluated.

Of the total solar radiation received at the ground, some is reflected, some goes to heat the earth's surface, some is sent back as long wave radiation, some is used in evaporation and the remainder is effective in heating the lower layers of the atmosphere. Estimates are made of the amounts used in the first four ways. These amounts subtracted from the average insolation received on clear days leave the effective insolation for changing the lapse rate near the ground.

The effective insolation at Chicago is arrived at in this way. Using these values, the maximum temperature was computed for several days when advective change was expected to be slight. The agreement with observation was found to be excellent. *Bulletin of the American Meteorological Society*, March 1941, pages 95–102.

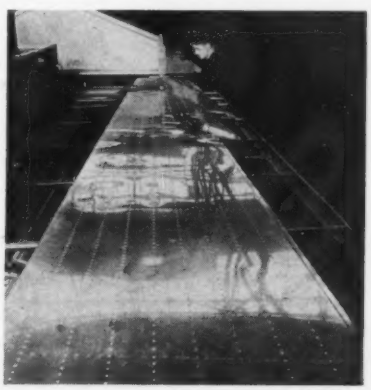
Military Aviation

Hitler's New Warbirds. Leonard Engel. This Spring, the *Luftwaffe* began using many new types of aircraft, some of which were modifications of familiar types, others embodying radical departures in design. This article gives some material on the general lines of new types such as the Focke-Wulf 158 single-seater pusher, the 189 twin-engined three-place fighter, the new modification of the "Kurier" four-engined commerce raider, the improved Junkers 88 combination dive and horizontal bomber, the 89 and 96 four-engined type as well as the new Dornier, Heinkel and Messerschmitt series. Increased armor, heavier armament and their possible effect on the future of aerial warfare are discussed. *Flying and Popular Aviation*, May 1941, pages 14, 15, 64, 66, 68, 5 illus.

Bombers to Britain—How? Tracy Richardson. American-built aircraft are being flown to England in a steady stream, shrouded in a cloak of secrecy. This article outlines the operational problems which confront transatlantic ferry pilots, many of whom are Americans, in delivering fully armed bombers across the Atlantic. The dispatching system which is designed to confuse spies, the precautions against forced landings at sea, and the weather conditions prevalent on this route are described. *Air Trails*, March 1941, pages 12, 13, 62, 1 illus.

Light Airplanes Defend the Vital Panama Canal Zone. An imaginative account of the part played by privately owned light airplanes in a fictional attack on the Panama Canal Zone. Written by an unnamed infantry officer, a veteran of Canal Zone duty, it suggests the yeoman's service that could be performed by light aircraft operating from beaches and savannahs and flown by private pilots who are familiar with the terrain. In this story, they carry communications, scout for the enemy, and even machine-gun troop positions in areas where heat and mechanical convection currents would make it dangerous for a large military airplane to operate. *Sportsman Pilot*, April 1941, pages 10, 12, 38, 1 illus.

Battle Tactics. A double-page spread of composite drawings intended to depict typical modern air battle tactics. *Air Trails*, May 1941, pages 18, 19.



Multiple riveting machines attaching stiffeners to the wing of a Curtiss Tomahawk.

American Aircraft Arriving to Defend Freedom's Fortress. A compilation of manufacturers', U.S. air service and British names for American-built airplanes now being supplied to the R.A.F. Representative British opinions on these are quoted. *Canadian Aviation*, April 1941, pages 42, 66, 2 illus.

School for High Fighters. Alexander McSurely. Out of the laboratory of the present war in Europe has come much valuable information on high-altitude combat conditions. Fighting at altitudes above 30,000 ft. is increasing; with it, the physical requirements of both men and aircraft become proportionately greater. In recognition of this fact, the U.S. Army Air Corps now conducts, at Wright Field, a course of instruction for pilots and flight surgeons to acquaint them with the physical dangers of high-altitude operation and the best techniques to counteract them.

Besides the director of the aeromedical research laboratory, the course instructors include observers returned from combat operations in Europe and a number of staff experts in widely varying aviation subjects. Special new flying clothing and equipment are being used in the course and improved as experience dictates. The nature and treatment of the course, together with the equipment and methods being used and developed are reported in some detail. *Western Flying*, May 1941, pages 18–20, 40, 8 illus.

Nederlandsch-Indie's Luchtmacht (The Dutch East India Air Force). Although the Dutch East India Air Force is not very large, its equipment is among the most modern. It consists of Glenn Martin bombers (WHII, WHIII, WHIIIA), Curtiss "Hawks" and "Interceptors," Ryan Trainers, and Koolhoven, Fokker CV and CX, and Lockheed scout airplanes. The personnel is highly trained and some of the pilots serve at present with the R.A.F. *Luchtvaart*, March 18, 1941, pages 102–105, 11 illus.

The New "War Birds." The Eagle Squadron of the R.A.F. went into active service as a fighter squadron on February 1st, equipped with Hurricanes. While it has had no opportunity as yet of meeting the *Luftwaffe* in combat, it has taken a full share of patrols in its allotted area. According to this account of the squadron, its members, all American volunteers, appear, in both flying ability and organized discipline, to be "worthy followers of their compatriots who joined the Royal Flying Corps in 1917." *The Aeroplane*, March 28, 1941, pages 362, 363, 4 illus.

Curtiss and Messerschmitt Do Battle. In a sham fight with a reclaimed Messerschmitt 110, a Curtiss Mohawk with the French armament was found able to get in many more bursts of gun-fire than its opponent by keeping within the turning circle of the Messerschmitt. This advantage presumes the altitude of both to be the same at the start and that the German would stay and fight. The Messerschmitt's extra speed and rate of climb, however, give it a decisive advantage depending on the comparative skill, training and bravery of the individual pilots. *Flight*, April 3, 1941, pages 256, 257, 4 illus.

Miscellaneous

Bottleneck in Brains. Bruce Campbell. Skilled aeronautical engineers and men trained in the theory of air-

plane design are, in the last analysis, the beginning of airplane production. With the sudden increase in aircraft building stimulated by the present crisis, the need for trained engineering help is being felt keenly. This survey indicates the number of men being graduated every semester by colleges and special engineering schools and their chances of placement. The important schools teaching aeronautical engineering are listed and notes on their courses are included. The article also contains comments by Admiral Towers and several important educators on the necessity for the rapid supply of these men to industry during and after the present emergency. *Flying and Popular Aviation*, May 1941, pages 44, 45, 60, 62, 103, 3 illus.

The Year in the Air. Reginald M. Cleveland. Reviewing 1940 progress in the aeronautical world, the automobile editor of the *New York Times* weighs the strategic and other aspects of military aviation in the current war and gives a statistical and factual summary of the expansion in American men, money, machinery and floor space devoted to British air aid during the twelve-month period.

Civil aviation for the year is outlined with figures and comments on pilot training, private flying, commercial aviation and the development of air lines, airports and airways. *Air Law Review*, January 1941, pages 1–10.

I Saw China Fight. Charles Healy Day. The pioneer airplane manufacturer, now trouble-shooting aircraft production in Canada after six years of building them "on-the-run" in China, presents an intimate picture of air power and air fighting in the Orient.

He finds the Japanese air force dangerously underestimated in America: "Quality, in planes they can put on the fighting line, is equal to ours and we don't compare when it comes to quantity." Aerodynamically, their planes left nothing to be desired and their craftsmanship is comparable to ours. The low-wing machines could flop over in a dive within an impossible loop of 300 to 400 feet, which might be attributed to a two-foot-high fin running from the cockpit back to the rudder fin. They developed extra fighter range for convoying bombers by attaching sheet-metal belly tanks which were dropped in flight.

While Chinese airplanes are far outnumbered by Japan's air force, the Chinese are better pilots and have a more natural instinct for flying, but their chief superiority is in their individualism. The drawback to Japanese pilots is poor eyesight, though their bombing has been improved by resorting to formation mass bombing. The Chinese are as capable as their enemies in making long and difficult flights. It is typical of the Japanese to be lavish in their use of bombs; wherever possible they will circle any of their own planes that have been brought down and bomb it to a twisted wreckage, whether their own pilots are still in it or not.

China will win if she is able to bring in her vital supplies and material. *Air Trails*, May 1941, pages 10–13, 60–61, 9 illus. Also condensed, *National Aeronautics*, May 1941, pages 16, 17.

Quick Shift. Ralph F. Kreiser. An account of the transfer of an entire Army flying school, the 79th School Squadron from Moffet Field to Kern County Airport in Bakersfield, 265 miles away in 24 hours. This transfer entailed not only moving the 60 airplanes and their crews, but required the erection of a tent camp for the cadets, instructors and enlisted personnel. *Flying and Popular Aviation*, May 1941, pages 50, 82, 2 illus.

Touring Test Board. Lieut. Frank Kurtz. The selection of Air Corps Flying Cadets today is a far cry from the highly competitive situation existing several years ago when waiting lists were long and physical requirements as well as educational prerequisites were more stringent. Selection today is simplified to such a degree that the Air Corps sends the Traveling Flying Cadet Examining Board virtually to the applicant's doorstep to expedite examination and admission. A member of this board describes how the system operates. *Air Trails*, May 1941, pages 21, 58–60, 2 illus.

North Atlantic Ferry. Capt. V. Edward Smith. A factual report on bomber delivery flights to England by an ex-ferry pilot. He finds the Atlantic "a formidable 'duck pond,' especially for mid-winter formation flights of land-planes navigating by dead reckoning, without benefit of radio and under wartime restrictions." The menace of enemy aircraft seems a minor problem compared to the difficulties which distinguish this kind of flight from routine commercial flying. The experience and sensations of the first trans-Atlantic ferry flight of bombers are described by the writer who was a crew member of the flight. *Aviation*, May 1941, pages 30, 31, 132, 134, 136, 2 illus.

How Aircraft Industry Is Solving Its Problems. A reprint from the *United States News*, which conducted a survey on American aircraft production. Conclusions reported in this article are that:

American airplanes are definitely standing up under combat conditions; those currently produced incorporate all the latest improvements. Production in 1941 should reach between 15,000 and 20,000 airplanes. Quality should supersede quantity since huge fleets of airplanes cannot alone achieve victory; aerial warfare is a race between engineers, with the Americans strong competition for the Germans.

Production capacity is the largest factor in a satisfactory defense program. Constant development and improvement together with precise manufacturing methods are necessary and make production a slow process at best. Principal barriers to production at present are raw material shortages accentuated by strike threats. Skilled labor demands are now being met but are serious in face of doubled expansion this year. Both the automobile industry and the farming out of parts orders are helping to expedite production, but both are yet to be fully developed and exploited. The advisability of decentralization of the industry is doubtful.

There is no categorical answer to the question of whether the air-cooled or the liquid-cooled is the superior engine. But American aeronautical engineers have developed the air-cooled engine and still place their confidence in it, preferring it, generally, to the liquid-cooled types used in German and British airplanes.

Bombers are being flown across the Atlantic—six or seven hours to Britain from Newfoundland. Flights also are made to Africa. New routes, with stops at Greenland and Iceland, are being studied for the lighter pursuit ships. American aircraft manufacturers appear confident that aid to Britain will arrive in time. *National Aeronautics*, May 1941, pages 12, 13, 2 illus.

Planes for Small-Town Papers. George R. Reiss. Large swift and expensive aircraft have become a standard part of the equipment of large metropolitan newspapers. They are used for far-ranging cameramen, to carry reporters and to transport executives. Small-town newspapers like the Youngstown *Vindicator* of which the writer is aviation editor, have shown that they can increase their reporting range by the use of light airplanes flown by members of their staff who hold pilots licenses.

Using light airplanes for aerial photography, for observation and other new tasks in small-town journalism, has paid large dividends and has been thoroughly justified in the experience of this editor. *Flying and Popular Aviation*, May 1941, pages 35, 36, 98, 99, 3 illus.

Transatlantic Bridge. DeWitt Wendell. As is well known, American built airplanes are being delivered under their own power to the R.A.F. in England. While it is not, as yet, a constant and uninterrupted stream, the system of operation has been established for taking off from Newfoundland, contacting convoys if necessary and landing the airplane at the assigned field at the time expected.

This article gives the history of the transoceanic ferry system, provides some notes on the method by which it is being carried out and some figures on the types being delivered to their destination entirely by air. *Flying and Popular Aviation*, May 1941, pages 18, 19, 68, 70, 72, 5 illus.

Directory of American Aircraft and Engine Manufacturers. An alphabetical listing of important airplane and engine builders, giving officers, key staff members and, where they exist, export representatives. One hundred and twelve companies are listed. *Western Flying*, April 1941, pages 30–35.

Quality in Warplanes. Condensed reprint of an article in *The Engineer* (London), analyzing the relative efficiency of British and German air forces. German numerical strength is in large part the result of their airplane designs being standardized for mass production at least two years prior to the war, while the British continued experiment and improvement of designs which were not ready for mass production when the war began.

While this fact accounts for British inferiority numerically, it is said to account in large measure for the superior performance of British aircraft as evidenced by the change in tactics forced upon the German air command. Brief contrast is drawn between the merits of British and German airplanes and the strategy of the two air forces. *Scientific American*, May 1941, pages 278–280, 4 illus.

Air Estimates. A summary of the speech of Sir Archibald Sinclair, Secretary of State for Air, introducing the 1941 Air Estimates in the British House of Commons on March 11th.

A number of new aircraft types were reported in the speech. Recent models of Spitfires and Hurricanes now in service are fitted with more powerful engines "which have considerably increased their speeds and provided the ability to fight at much greater heights, while heavier armament has increased their fire power. The new Hawker Tornado is equipped with engines of nearly twice the horsepower of the fighters which bore the brunt of the Battle of Britain, and can carry still heavier armament, yet obtain speeds well in excess of 400 m.p.h. Other engines of as great and even greater power are coming on."

New twin-engine fighter types include the Whirlwind, and for long-range fighter operations and for night fighting, the Beaufighter, each with a very heavy armament. Hampden, Wellington and Whitley bombers, which have constituted the R.A.F.'s main offensive armament, are now in recent models "fitted with more powerful engines which give them increased performances and striking power." Some of them, although the name remains the same, are really quite different aircraft. But these are being replaced by a range of very much heavier bombers including the Stirling, Manchester and Halifax, which are more than twice the size of any earlier type; they are faster and carry not only a heavier defensive armament but also three times the weight of bombs for the same distance as their predecessors.

Favorable comment on American aircraft in British service include the Harvard trainer (NA-16-3), the Lockheed Hudson (EB-14B) general reconnaissance airplane, the Brewster Buffalo (439) fighter, the Mohawk and Tomahawk (75-A and 81-A) Curtiss fighters, the Glenn L. Martin Maryland (167-B4) medium bomber, the Douglas Boston (DB-7B) medium bomber, the Consolidated Liberator (32) heavy bomber and the Consolidated Catalina (28-5) flying boat.

Speaking of British air operations, R.A.F. aircraft losses in the past 10 months were said to be less than 1,800 as against the destruction of some 4,250 German and 1,100 Italian airplanes. British bombers during that period made 260 raids on airdromes and seaplane bases, 300 on docks and shipping, 470 on railways and communications and 630 on industrial targets—all these in Germany. Many heavy raids were also made on objectives in occupied territory. In the last 10 months of reconnaissance across the sea, convoy patrol, attacking warships, U-boats and merchant vessels, and photographing and bombing enemy bases, the aircraft of the Coastal Command flew 16 million miles.

Contributions of colonial and Allied squadrons are mentioned as a great and increasing element in British strength, but no figures on their activities are given. It is said that no reduction in the standard of training has been accepted and that the success of the empire air training scheme has surpassed all expectations. After $5^1/_2$ weeks in operation, the Air Training Corps scheme, covering the youth of the country as a whole, had 1,051 units with over 130,000 boys. *Flight*, March 20, 1941, page 222. Also *The Aeroplane*, March 21, 1941, pages 331, 332.

Naval Aviation

Ferry Hop. Marsh W. Miller, Jr. A Naval Reserve officer's account of a routine transfer flight from Honolulu to Cavite, P. I., as part of a formation of Consolidated PBY patrol bombers. *Flying and Popular Aviation*, May 1941, pages 20–22, 100, 5 illus.

Air Borne Torpedoes. P. W. Brooks. A survey of the construction, carriage and naval application of torpedoes designed to be dropped from aircraft. This article briefs the history of the Whitehead torpedo, first used as a destroyer and submarine missle, and explains its construction and evolution since its invention at the end of the last century. Torpedo carriage by airplane was first considered by the British admiralty in 1911, and several types of seaplanes were developed before and during the first World War to carry this weapon into naval action.

The first successful air torpedo attack against a surface vessel took place in the Sea of Marmora, late in 1915. A short history of the development of the torpedo carrier is given with an explanation of the technique used in launching the missile. A table of successful aircraft torpedo attacks which have taken place since 1915 is also provided. *Aeronautics*, April 1941, pages 46–50, 8 illus.

The Vast Program of Advanced Bases for Our Navy. T. N. Sandifer. A survey of the work completed and under construction on advanced naval and air bases in the Pacific, the Caribbean and in Alaska. Following the philosophy that attack is the best defense, seaplane bases, repair stations and in some cases, facilities for shore-based aircraft have been created in far-flung places such as Olongapo, P.I., Samoa, Christmas Island, Sitka and Dutch Harbor in Alaska. This presentation includes a summation of the military theory and the actual construction and equipment problems involved in creating these advanced bases. *U.S. Air Services*, April 1941, pages 12, 13, 36, 1 illus.

Flying Fleet. James L. H. Peck. To furnish familiarity with the functions of the U.S. Naval Air Service and the equipment used in maintaining strategic security and control of some millions of square miles of sea and coast, this article describes the various types of aircraft employed, including the latest models and the Navy ships from which they operate. *Air Trails*, May 1941, pages 17, 55, 56, 3 illus.

Shell Spotters. John R. Hoyt. A narrative relating the hazards of an SOC dive bomber's job in spotting enemy ships and directing shell fire by radio. The keen judgment, delicate timing and quick response so necessary to this kind of flying are realistically described from the poised moment before being catapulted into the wind to the spotting and directing of shells, the countering of assault by enemy pursuit airplanes and back to the particularly hazardous "cast recovery" by the cruiser (landing alongside the moving ship to be taken back aboard). *Air Trails*, May 1941, pages 20, 50, 51, 1 illus.

Parachutes

"Shooting" the 'Chutes. A detailed description of the whirling parachute tower designed by Prevost Smith, son of Floyd Smith, famous pioneer pilot and developer of the free manual type of parachute. The article also contains a brief outline of Floyd Smith's flying career which began in 1914 and included such experiences as early test flying and the postwar experiments with the forerunners of the present-day service type parachute. *Yankee Pilot*, May 1941, pages 9, 10, 1 illus.

Producing 'Chutes. Double-page picture spread showing what is behind the scenes in building the Switlik parachute. Similar to the manufacturing of clothing, the technique of parachute production requires the most perfect workmanship; every step must be inspected. Captions explain the production methods illustrated by the photographs. *Aviation*, May 1941, pages 46, 47, 8 illus.

Como se Fabrica un Paracaidas Moderno (Construction of the Modern Parachute). The highly specialized art of various types of parachute construction is described in considerable detail with an account of how they are packed, operated and maintained. Notes are included on the characteristics of parachute materials, which are subjected to strict examination. *Aeronautica*, December 1940, pages 22, 23, 47, 2 illus.

Problemi del Paracadute alle Alte Velocita (Problems of Parachutes at High Speed). A. Bruno. A discussion of the forces which act on a parachute when opening at high speed and of the relation of these forces to the strength of the parachute itself and to the parachutist. An examination is made of the possibility of decreasing the value of such forces by means of a "cushioning action" and by a progressive unfolding of the parachute. In conclusion, a suggestion is offered for a new type of parachute applicable to high speed. *L'Aerotecnica*, February 1941, pages 95–108, 11 illus.

Personalities

Father of Flivver Planes. A brief picture of C. G. Taylor and his role in developing the first popular-priced airplane, the Taylor Cub. Reminiscences of his early connections with aviation elucidate the character of Mr. Taylor and his phenomenal success in the manufacture of aircraft. *National Aeronautics*, May 1941, page 10, 1 illus.

Safety Detective. The aeronautical background and achievements of Jerome Lederer, Director of the Safety Bureau, Civil Aeronautics Board, are noted in vignette form. *National Aeronautics*, May 1941, page 17, 1 illus.

C.-in-C. Fighter Command. Oliver Stewart. A thumbnail sketch of Air Marshall William Sholto Douglas, Air Officer Commander-in-Chief, the Fighter Command, who began his career as a fighting pilot during World War I. *Aeronautics*, April 1941, 1 illus.

Westover's General Brooks. Martin Green. . An outline of Brigadier General John B. Brooks' career as a military aviator. His first flying assignment was with the Mexican Punitive Expedition in 1916. In the quarter of a century since then, his work has taken him as far West as Hawaii and as far East as the bases on Long Island. His latest assignment is command of the new base at Westover Field, Chicopee Falls, Mass. *Yankee Pilot*, May 1941, page 15.

Pursuit Pilot. Hickman Powell. A character study of Lieut. Philip G. Cochran, flight leader of the 33rd Pursuit Squadron now stationed at Mitchel Field. His job is to make fighting pilots of the basic trainer cadets assigned to him—a transition likened to changing from a saddle horse to a bucking bronco. Basic signals, air discipline, navigation and combat flying, the finishing touches that the squadron leader gives to his juniors are explained. *Popular Science*, May 1941, pages 52–58, 220, 14 illus.

Robert F. Six. A vignette of Continental Air Lines' 34-year old president, Robert F. Six. Notes on his rise from the struggling operator of a country town flying school to the management of an important air transport operation. *Western Flying*, May 1941, page 27, 1 illus.

Personairlities. Bob Insley. Cy Caldwell. A biography of Robert Insley, vice-president and chief engineer of Menasco Manufacturing Company. *Aero Digest*, May 1941, pages 90, 121, 1 illus.

Boeing—Fabulous Person. Victor Shawe. The Story of William E. Boeing, son of a wealthy Seattle lumberman who was catapulted into the airplane manufacturing business when a float was wrecked on his Martin seaplane in 1915. Since then the Boeing company has built many types of aircraft, from twin float trainers to Clipper flying boats and Stratoliners. This biography lists all of the famous "firsts" starting with the first international air mail in 1919 accomplished by Boeing airplanes. *U.S. Air Services*, April 1941, pages 21, 22, 2 illus.

William W. Finlay. Highlights of the aviation career of William W. Finlay, newly appointed manager of the Wright Aeronautical Corporation's plant at Lockland, Ohio. Finlay, who finished his course in engineering, decided to start the hard way, by forgetting his degree and apprenticing himself to a tool maker and machine tool builder. He came to aviation *via* the tool and gage shop, marine and automobile engine factory, shipyard, can plant and pump works. *U.S. Air Services*, April 1941, page 34.

Photography

Flying Cameras. Alfred Toombs. A study of the use of aerial photography in the present conflict in Europe has so impressed the directing strategists of the Army Air Corps that a special fleet of fifteen Beechcraft F-2 twin-engined low-wing monoplanes were ordered by the Air Corps and delivered to a new unit known as the First Photographic Squadron. This article contains figures on the new airplane, a military version of the Beechcraft 18S, powered with two Pratt & Whitney 350-hp. Wasp Jr. engines. The special reinforcements, the photographic equipment, darkroom and flying characteristics are also described.

Some of the new uses to which the aerial camera has been put in the recent battles abroad, and some of the newly developed military practices which have been derived from these uses are outlined. *Flying and Popular Aviation*, May 1941, pages 23, 24, 101, 4 illus.

Fleet Air Arm Fighter. Photographs of the Royal Navy's eight-gun, Merlin-engined Fairey Fulmar in flight. *Flight*, April 3, 1941, pages 254f-g, 5 illus.

Stukas in Action. Photographs from Germany showing Junkers Ju 87B dive bombers (1,200-hp. Junkers Jumo 211 D) in training over the bombing range. Caption says these

are used by the *Luftwaffe* as advanced striking units of the German Army and that against strong air defense the Stukas "invariably suffer very heavy losses." The Breda 201 Picchiatelli dive bomber is the Ju 87B built under license at Milan. *The Aeroplane*, March 21, 1941, page 335, 5 illus.

Private Flying

Airplanes—Stay Away! William D. Strohmeier. After a flight over the Everglades of Florida and a deer-hunting trip into the heart of this mysterious semi-tropical jungle in a J-2 Cub in the company of a native pilot, the writer states his reasons for advising pilots to avoid the area. *Flying and Popular Aviation*, May 1941, pages 42, 43, 88, 90, 3 illus.

Five Men and a Plane. Edward Churchill. Contrary to popular belief, not everyone in the motion picture-radio group in Hollywood can afford to own a private airplane. Five private pilots from this clique who could not afford to own an airplane by themselves pooled their resources and purchased a Stinson 105 for their collective use. To avoid the evils that bedevil many such enterprises, a set of sensible rules were created which have thus far worked out remarkably well. The fuel problem is solved by the simple expedient of the pilot filling the tank after he is through flying. Thus, he pays for the gasoline he uses and leaves a full tank for the next fellow. Failure to do this is punished by a fine plus being billed for the gasoline. Other infractions are similarly penalized. The money collected in this manner is used for minor repairs. The entire financial setup of this small flying club which applies some of the oldest flying club practices and adds a few new ones, is described. *Flying and Popular Aviation*, May 1941, pages 26, 27, 95, 96, 4 illus.

Super-Service Specialists. Hill Edwards. The story of Richard Arlen, actor and World War pilot, who gave up private flying three times in two decades because good equipment, properly maintained, was either too expensive or simply unavailable. Finally, Arlen decided that he would do something about it. Joining forces with a pilot-operator, Dick Probert, he took over a dilapidated hangar at Van Nuys Metropolitan Airport. This is an account of how they converted it into one of the most progressive fixed base operations units on the Pacific Coast. *Flying and Popular Aviation*, May 1941, pages 16, 17, 80, 82, 4 illus.

I Learned about Flying from That! No. 25. Herbert L. White. The writer, a test pilot and motion picture aerobat relates the most hazardous situation of his career; getting into instrument weather in an overloaded light airplane. *Flying and Popular Aviation*, May 1941, pages 39, 93, 94, 1 illus.

Water Preferred. Howard Hasbrook. Its advantages over land in sport, utility and safety have brought seaplane flying into the upswing, according to this enthusiast who finds seaplane flying "fun," but different from flying a light plane with wheels. As a convert to floats, he tells what to expect. *Air Trails*, May 1941, pages 14, 15, 52, 53, 6 illus.

The Battle of Pennsylvania. Wolfgang Langewiesche. Setting out to survey some of the traditional hazards of flying across Pennsylvania's Alleghenies, the writer made a flight through that country and talked to local pilots, who "fly through that country successfully and comfortably at all seasons." They say that it involves no special tricks; it is just a question of flying a straight compass course—figure out a compass heading and fly it; correct it for drift by landmarks and then hold it; keep a check on your ground speed; keep alert and identify landmarks positively; note down times-over-places—"and you can't very well help getting there."

Despite the fact that the Alleghenies reach only 2,500 or at most 3,100 ft., their "bugaboo" lies in their bad weather, especially fog and clouds. The most common error made in flying over Pennsylvania invariably winds the pilot up in Maryland: that is, thinking of the mountains as running north-south; they run exactly north-east to south-west. Therefore the compass is essential.

Discussing the flight geography of this part of the country, the writer explains how to fly it independently of the weather and how to reduce the bad, weather-vulnerable, engine-trusting part of the flight to one or two short jumps of about 30 minutes each, remaining within reach of pleasant flat fields the rest of the time. *Air Facts*, May 1941, pages 10–26, 5 illus.

Propellers

Balancing of Aircraft Propellers. R. K. Mueller. The fourth in a series on propeller balance, this installment deals with structural unbalance caused by normal erosion and similar phenomena encountered during actual service. The system of adding counterweights to correct this tendency is explained together with the theory applied in measuring this unbalance. The apparatus developed jointly by Westinghouse Electric and Manufacturing Co. and Hamilton Standard for measuring the amplitude of vibration due to propeller unbalance is described; its use in actual tests is outlined. *Aero Digest*, May 1941, pages 180, 183, 184, 187, 192, 4 illus.

Der Fliehkrafteinfluss auf die hoheren Biege-Eigenfrequenzen von Luftschrauben bei verschiedenen Anstellwinkeln (Effect of the Centrifugal Force on the Higher Natural Bending Frequencies of Propellers at Various Propeller Blade Angles). J. Meyer. From the solution of the differential equation of an oscillating cable within the centrifugal field, the effect of the centrifugal force on the higher natural bending frequencies of propellers at various propeller blade angles is estimated. *Luftfahrtforschung*, February 1941, pages 24, 25, 1 illus.

Acoustical Studies of the Flutter of an Airscrew (Investigations of Airscrew Flutter. Part II). Juichi Obata, Major Yûzô Matumura and Ryô Kanayama. Part I of this paper describes the nature of the sound that is produced by the flutter of a propeller. Part II deals with the nature of propeller flutter itself, which is a phenomenon supposed to be a form of severe vibration of the propeller blade and is easily recognized by a sudden and remarkable increase in the sound emitted by the propeller.

According to the writers, flutter results in frequent propeller failure and is experienced more frequently with the metallic propellers now used than with the wood propellers used prior to the development of very high-powered engines. This article represents investigation of the origin of the phenomenon and of means for its prevention.

By comparing the results of analysis of the flutter sound with the period of natural vibration of a non-rotating propeller, and also by taking into account several examples of breaking blades, the modes of vibration that are excited when flutter occurs were estimated to be: (1) third mode of bending vibration, approximate frequency = 115; (2) first mode of torsional vibration, approximate frequency = 315; (3) second mode of torsional vibration, approximate frequency = 590. It was, moreover confirmed that bending vibration scarcely appears, at least when the propeller is rotated by means of an electric motor. *Report of The Aeronautical Research Institute, Tokyo Imperial University*, No. 202, November 1940, pages 556–590, 9 illus.

Radio

Airlines' Aircraft Radio. David S. Little. Radio equipment in airline operation serves two general and frequently overlapping functions—com-

munication and navigation. Typical of the complete radio equipment used on transports in the United States are American Airlines' variety of receivers, the design and functions of which are described in this article.

The mainstay of American's receiving equipment is the Western Electric Type 14B primary radio-range receiver covering the frequency band of 200 to 400 kcs. Next in importance is the Sperry Automatic Direction Finder (ADF), incorporating an 11-tube superheterodyne receiver and a shielded twin-loop antenna. This equipment, once tuned to a station, gives a continuous heading in the direction of the tuned station.

The third set is a four-tube, two-band RCA Model AVR-7A superheterodyne covering the 200–400 and 2,300 to 6,800 kcs. This set is used as an auxiliary range receiver to check radio-range intersections and for listening to weather reports and airport control towers. The fourth set is the Western Electric 27B UHF marker receiver, which actuates three signal lamps on the instrument panel, identifying airway, outer and inner radio markers, respectively. The transmitter is a Collins Type 17F-9. The installation, antennas, mounting and use of this radio equipment in airline operation is explained in such a manner as to be useful to non-scheduled pilots using the airways. *Aero Digest*, May 1941, pages 64, 67, 68, 71, 8 illus.

Stress Analysis

The Part of Shear in the Deformation of I-Beams. Jean Drymael. Under the influence of civil engineering construction, the part played by shear in the deformation of beams is usually neglected. In aircraft construction, where weight is important, the approximation is sometimes rough.

It is shown that, in I-beams, it is simple to take the deformation due to shear into account, and it appears due chiefly not to elementary deformations distributed along the length, but to discontinuities in the slope wherever there is a concentrated load, namely, at the supports. *Journal of the Royal Aeronautical Society*, April 1941, pages 141–147, 7 illus.

Least Work Solutions of Shear Lag Problems. Eric Reissner. The problem of the distribution of stresses in the cover sheets of box-beams, acted upon by bending loads, is treated by assuming parabolic bending stress distributions across the sheets and by determining the spanwise variation of the shape of these parabolas with the help of the method of least work (Castigliano's principle). A second order differential equation is obtained for the spanwise variation of the vertex curvature of the stress parabolas (which in the ordinary beam theory are straight lines). The equation has constant coefficients if there is no taper in sheet width and thickness, variable coefficients for tapered sheets. The equation is found to be integrable in terms of elementary functions for untapered beams and for a general class of tapered beams.

The solution for beams of constant cross-section is worked out explicitly and applied to the analysis of a series of beams having different load distributions. For beams of constant cross-section an approximate formula is developed for the amount of shear lag at the most highly stressed section, this being in general also the section of greatest shear lag. This formula depends on the ratio of sheet width and distance of the center of gravity of the load curve from the root section, on the elastic moduli and on the relative stiffness of flanges and sheets. Further it is shown that a design is possible such that no shear lag occurs. The method developed, and extensions of it, should permit a relatively simple solution for most practical problems in this field of stress analysis. *Journal of the Aeronautical Sciences*, May 1941, pages 284–291, 5 illus.

Permanent Buckling Stress of Thin-Sheet Panels under Compression. W. L. Howland and P. E. Sandorff. The problem of permanent skin buckles in thin-sheet panels under compression is attacked from both an experimental and a theoretical point of view. A simple theory is developed relating permanent buckling stress to the critical buckling stress of the sheet, and is substantiated by experimental results. A method of analyzing experimental data on buckle depth, measured in the course of panel tests, is presented. Objectionable permanent buckles are shown to be dependent upon the relation between maximum applied stiffener stress, critical stress, design load factor and distribution of material between skin and stiffener. A summary of data covering a wide range of stiffened sheet design is given, and empirical curves based on this data furnish a means of estimating the permanent buckling characteristics of proposed designs. *Journal of the Aeronautical Sciences*, May 1941, pages 261–268, 10 illus.

Begrenzung von Resonanzdrehschwingungen durch einen Schwinger mit gekrummter Federkennlinie (Limitation of Torsional Resonance Vibrations by Means of an Oscillator with a Curved Characteristic Elastic Line). K. Maier, V.D.I. The vibration reducing effect of elastic couplings and of oscillators with curved characteristic elastic lines has formerly been ascribed to their damping properties. Tests on an aircraft engine proved that proper resonance between the oscillator mass and the elastic deflection exceeds by far the effect of friction. *Luftfahrtforschung*, February 1941, pages 18–23, 13 illus.

Stress Distribution in Metal Covered Wings and Similar Structure. L. Crowther. Recent investigations show that shear lag has a small effect on the distribution of the bending stresses in the section. But the effect of the stiffness variation of the various parts of the structure has a considerable bearing on this distribution.

A method of stress determination is presented. It takes no account of the stiffening effect on the edges of the covering by the spars. But it is considered that if a panel of the covering is tested in compression to determine the effective E and the failing stress, this method is more accurate than the ordinary engineer's method generally used, and also gives a more economical distribution of the bending stresses. An example and typical panel tests are described. *Journal of the Royal Aeronautical Society*, April 1941, pages 148–151, 2 illus.

Warfare

Averting Death from the Skies. Faced with the possibility of having their cities attacked from the air, engineering schools, architects organizations and passive defense specialists in the United States have made a study of air raid defenses in Europe and are preparing to apply their findings to American cities. This article outlined the methods by which common materials can be used to turn cellars, subways and similar evacuations into safe air raid shelters, and describes special buildings which might be built to protect civilians from bomb injury. The bomb-resistant properties of brick, stone, sand and other common materials are discussed. *Popular Mechanics*, May 1941, pages 648–651, 149A, 151A, 11 illus.

The Luftwaffe's Daylight Effect. Reviewing details of last Autumn's air attacks over England as described in the pamphlet "Battle of Britain" published by the British Ministry of Information, this editorial finds the pamphlet "admirably written,

with an occasional concession to popular taste in descriptive and emotional style . . . generally sound in technical sense . . . a clear idea of the changing strategical objects of the fighting . . . new light thrown on the numbers engaged and the tactical methods employed." Pertinent extracts from the pamphlet are quoted. *The Aeroplane*, April 4, 1941, pages 377, 378; *Flight*, April 3, 1941, page 255.

The 82nd Week of the War in the Air. Countering certain Press demands for reprisals by the British Bomber Command against German cities, the strategy of British air objectives is clarified and the futility of attempting to out-reprisal the enemy in the face of a far wider front and a far greater distance is emphasized. It is pointed out that while British bomber strength is increasing daily, both in power and range, it is not yet equal to that of the enemy and must therefore make efficient use of every airplane and every bomb employed.

Targets of the Bomber Command are all said to be essential to Germany's war effort—all more important than women and children, and any bomb which misses a military target and kills civilians not engaged in war work is a bomb wasted. The view is taken that "reprisals would but invite increased reprisals on British cities, and at present the enemy is in a position to exceed our own maximum effort against such unprofitable targets as women and children—and in more concentrated form." *The Aeroplane*, April 4, 1941, page 379, 2 illus.

The 80th Week of the War in the Air. 36 German bombers are said to have been shot down after dark during the week, 21 of them by intercepting night fighters. Hawker Hurricanes, Boulton Paul Defiants, Bristol Beaufighters and "probably a few Douglas Bostons, as well as a Supermarine Spitfire shared honors." The Beaufighter, powered by two Bristol Hercules motors, is said to be "just the sort of long-range fighter with exceedingly powerful armament which the Royal Air Force has lacked for so long." Converted to a fighter the Douglas Boston would come into much the same category.

The new bombers, Short Stirling, the Avro Manchester and the Handley Page Halifax, weighing twice as much as their predecessors and carrying three times the weight in bombs for the same distance are already reported in use. *The Aeroplane*, March 12, 1941, page 327, 1 illus.

Before "Dunkerque." An account of the composition and activities of the Air Component of the British Expeditionary Force prior to its evacuation from France. Three classes of aircraft were used: Lysanders for tactical reconnaissance, Blenheims for strategical and night reconnaissance and squadrons of fighters for the protection of the others. For the odds facing them, the squadrons of the Air Component won great victories during the invasion of the low countries and the evacuation from France, in spite of heavy losses endured. *Flight*, April 3, 1941, pages 254a-c, 4 illus.

War in the Air. Amid reports on the progress of the war are scattered notes on the role of aircraft. The R.A.F. had the job of bombarding inaccessible mountain defenses of the Italians near Keren in Eritrea, and cleared the way for artillery to move in. Troops and political officers transported by air were used in Abyssinia. An account is given of highly successful cooperation between the S.A.A.F. aircraft and British warships off the coast of Somaliland, where the aircraft registered targets for the warships and corrected initial salvos with very accurate fire resulting.

R.A.F. and Fleet Air Arm operations accounted in part for the success of the naval engagement in the Ionian Sea, scoring hits on Italian warships. The R.A.F. operated in force during the Balkan crisis and undertook the bulk of the air work. *Flight*, April 3, 1941, pages 251–253, 2 illus.

How Homes Can Be Protected from Air Attack. Col. A. M. Prentiss. A study of the ratio of time spent at work, leisure and rest shows that an average citizen is more likely to go through an enemy attack at home than anywhere else. It is important, therefore, that private homes be adequately protected. This article contains descriptions and directions for building and equipping various types of shelters for individual families. *Popular Science*, May 1941, pages 77–80, 218, 7 illus.

Are Skyscrapers Bombproof? Ely Jacques Kahn, New York architect states that American skyscrapers, long the butt of European's jokes are almost the ideal structures to resist aerial bombardment. Comparing these structures with English timber and masonry houses, the skyscraper with its fire-proof construction, its reinforced roof and flexible steel frame can absorb an attack that would demolish the average British building. Kahn suggests the construction of permanent underground shelters for crowded cities, and states that slum areas are a worse menace in war than they ever were during peace times. *Popular Science*, May 1941, pages 81–84, 7 illus.

Yankee Eagle over London. Gene Tobin. A personal account of the air battle over London that took place on September 15, 1940, in which 185 enemy aircraft were brought down. The writer describes his part in accounting for two of these and his emergency landing with a crippled undercarriage. *Liberty*, April 26, 1941, pages 63–65, 1 illus.

The Advanced Air Striking Force. Review of the book of that name written by Charles Gardner, British Broadcasting Corp. observer. Of the many books on this subject, this is the best written and most readable; its author has a knowledge both of aircraft and of the R.A.F. A valuable picture is presented in this record of the author's experiences and observations while stationed with the A.A.S.F., which was an independent force under the operational control of the Bomber Command, using advanced bases in France until the evacuation. *Flight*, April 3, 1941, pages 254c-d, 2 illus.

The Principles of Anti-Aircraft Gunnery. Felix Griffin. In an article written to enlighten flying personnel on the problems of anti-aircraft gunnery, it is pointed out that there is a visible similarity between the tasks of the anti-aircraft gunner and the bombardier in a high flying bomber. While the bombardier in his moving platform is trying to hit a fixed object, the anti-aircraft gunner from his fixed station is trying to throw a shell at a moving target. The fact that the bomber must travel a constant course at constant speed at a uniform altitude makes the problems even more similar.

Time is the A-A gunner's chief problem. Considering the lapse between the time the shell leaves the barrel, the gunner must determine the bearing, angle and flight-time of the target airplane at the time the shell reaches it. The instruments used in predicting these figures, the system of firing and correction, the placement of the equipment and the application of light, rapid-fire equipment against low-flying airplanes are explained. *Aeronautics*, April 1941, pages 66, 67, 2 illus.

Med 19 Flygflottiljen I Finland (With the 19th Finnish Flight Squadron). An account of the defense activities of the Finnish pursuit pilots operating against the Soviet air force during the recent Russo-Finnish war. *Flygning*, April 1941, pages 13, 22, 2 illus.

(*Continued on page 67*)

Flight Theory

Among aviation publications there are few books for pilots concerning this phase of growing importance in their training. It is not surprising in that the industrial branch and the operation end of aviation seldom meet. Flight theory and aerodynamics were not necessarily a part of pilot training formerly, but remained intimately within the domain of the aeronautical engineer. The engineer, on the other hand, was often as not unfamiliar with the many problems encountered by pilots under various conditions. Pilots being generally unfamiliar with the language of the designers, technicians, and engineers, have consequently found the texts complex and uncommunicative. The ground instructors are rare who can interpret the subject to the student's advantage, and in a day when the wealth of nations is poured into greater aircraft performance, a link of understanding between the pilots and designers should be securely wrought.

A text from the pilot's standpoint, with the necessary facts and conclusions, with a minimum of mathematical discussion and no theoretical analysis of doubtful trainee-pilot value is found in this recent addition to the D. Van Nostrand Company's aviation bookshelf. The approach is extremely basic and the subject matter wanders very little from the conventional light plane design. No attempt is made to cover a variety of cases under each subject head, but this lack of scope should be of definite value in primary and even advanced training, as long as the theories remain basic.

The illustrations are clear-cut and often replace text material. Throughout the examples and discussion, a single plane representation and single airfoil section are adhered to. However, under such subject heads as "Control Surfaces," "High Lift Devices," etc., a necessary variation is made to take care of the numerous present-day combinations.

The main portion of the book is appended by relative material, among which is found a subject of increasing interest, "The effect of flying on the pilot." This is presented from the more or less cold-blooded physical side, explaining bodily reactions in various flying attitudes—interesting and awakening to many pilots. An aerodynamic glossary completes the book, and should provide the pilot with a vocabulary to the language of the aeronautical engineer, although few of the technical terms contained therein will be found otherwise in the book.

Books reviewed in this section may be purchased, or borrowed without charge, from The Paul Kollsman Library, Institute of the Aeronautical Sciences, 1505 RCA Building West, Rockefeller Center, New York, N. Y.

While the text is not the complete answer to all of the pilot's problems, nor does it approach an unlimited source for the unraveling of knotty aerodynamic problems for the pilot's benefit, it does seem to fill a large gap in making available either as a text or as a reference book a ground of common understanding between laymen, pilot and aeronautical engineer.

P. V. H. Weems
Lt. Comdr., U.S. Navy (Ret.)

Simplified Theory of Flight, by T. C. Gillmer and H. Erich Nietsch; D. Van Nostrand Company, New York, 1941; 162 pages, $2.00.

Practical Meteorology

The second edition of this standard work on meteorology for air line and non-scheduled operations differs from the 1939 edition in modernizations, such as conversion of barometric readings from inches of mercury into millibars. This thoroughly practical work gives only small space to such elements as the study of the composition and nature of the atmosphere and the instruments used to observe its changes.

Practical work begins with the study of the nature of air masses, their sources and classification. The continents and the various types of air masses native to each are named and their properties examined. This is followed by a study of fronts and frontogenesis, the structure of extratropical cyclones and violent weather phenonema such as thunderstorms, tornadoes and hurricanes.

The nature, formation and classification of clouds and fog are particularly well explained in the light of the latest material gathered on the subject. In a special chapter, this material is then applied to aviation particularly, giving special attention to rough air, icing conditions and other special meteorological conditions whose forecasts must be made available for safe scheduled operations.

The remainder of the book deals with the making and interpretation of weather charts, the mathematics of weather forecasting, the operation of an air line meteorological department and a study of climatology. The appendix contains a handy glossary, modern conversion tables, symbols, charts and other useful data.

Aeronautical Meteorology, by George F. Taylor; Pitman Publishing Corporation, New York, 1941; 432 pages, $4.50.

Anodizing Aluminum Alloys

This monograph deals with the electrolytic and chemical production of protective surface film on aluminum and its alloys and with the use of such film in practice. Part one comprises a general treatment of the subject. A survey of the electrochemical process under discussion is presented with an outline of the behavior of metals toward gases and the anodic phenomena at metallic electrodes. Included in this section is material on the chemical properties of aluminum and the electrolytic behavior and anodic oxidation of aluminum. This data is subdivided under direct current, alternating current and combined current treatment.

Part two is a specialized section. It treats of the properties of protective films, the chemical phenomena at electrodes and in electrolytes, and the practical aspects of anodic treatment. An account is given of the commercial anodic processes available for the creation of protective films on aluminum and its alloys.

Anodic Oxidation of Aluminium and Its Alloys, by Dr. A. Jenny; Chemical Publishing Company, New York, 1940; 231 pages, $6.50.

Poetic Flight

If one likes to read aviation history in poetic form, this book will provide interesting side lights on some of the better known names, beginning with Icarus. The poem is written in a form of blank verse and contains the imagery and poetic license permissible to the style. Evidently the author did a large amount of research work, indicated by the useful acknowledgments given at the end of the book.

While his treatment of Icarus and Leonardo is in a style befitting the subjects, poetic phrasing makes more difficult reading of the history of the prosaic and practical Wright brothers. But the unique presentation of this epic achievement may make a deeper impression than the many other accounts of the same events have ever done.

The author does not adhere to the idealism of most poetry. Such lines as, "Aerodrome did a flop," "How Professor Manly got ducked" and "Will, if you keep on with these monkey doodles you'll go crazy" indicate how colloquialisms creep in.

The latter part of the book recounts the experience of an Italian poet-pilot whom the author terms "a kind of Steve Brodie of the air," whose *Icaro* won the Olympic poetry award in 1930.

Differing from any other aeronautical book on record, this work will have a strong appeal to those who like to take wing with the Muses.

The Airmen; a Poem in Four Parts, by Selden Rodman; Random House, New York, 1941; 148 pages, $2.00.

Aeronautics for the Mechanic

Any text designed for young men preparing to work in airplane factories or at airports needs to be both thorough and comprehensive if it is to help the mechanic get his first job and hold it once he has it. The authors of *The Aviation Mechanic* have successfully brought to bear in this book the full impact of their broad knowledge of the subject and their long experience in the training of young men for jobs in aviation.

Throughout each chapter, the importance of the mechanic's job stands out boldly in its specific relationship to each and every phase of airplane construction and maintenance. The book covers the whole range of the mechanic's work and the fields with which he should be familiar—from introductory information about the airplane and how it flies to the construction and maintenance of airplanes and aircraft engines. The treatment includes every type of aircraft—large and small, civil and military.

Spot-welding fuel tanks at the Glenn L. Martin plant. From *The Aviation Mechanic.*

The section on airplane construction furnishes unusually thorough coverage of the subject for a book of this type. Almost a hundred pages are given to a detailed and well-organized discussion of fabrication materials, principles and methods. This study leads into a practical description of each successive step in the building of a light, all-metal airplane. Proceeding with an account of the construction processes and the production flow in a typical light airplane factory, the authors conclude the section with a very instructive picture-and-text presentation of large factory production of heavier airplanes.

Maintenance and repair in all their aspects comprise the last half of the book. They are handled from the standpoint of private and commercial as well as military aircraft and engines. In addition to servicing practice and methods, which are standard material in texts on aviation maintenance, considerable information is furnished on "trouble-shooting" to determine causes for failure. The organization of maintenance and overhaul operations at airports and at military and commercial air bases is touched upon to show the functional relationship between the various service operations.

The quantity of excellent illustrative material includes many half-tones, line drawings and cutaway sketches. The selection of illustrations reflects the great care taken by the authors to afford a perfect understanding and practically a finger-tip knowledge of the material contained in the text. Quite apart from its utility to schools, this book presents a most suitable medium for self-study, though the preface cautions that aviation mechanics cannot be learned altogether from books and that those making a career of aviation should get the best school training they can afford.

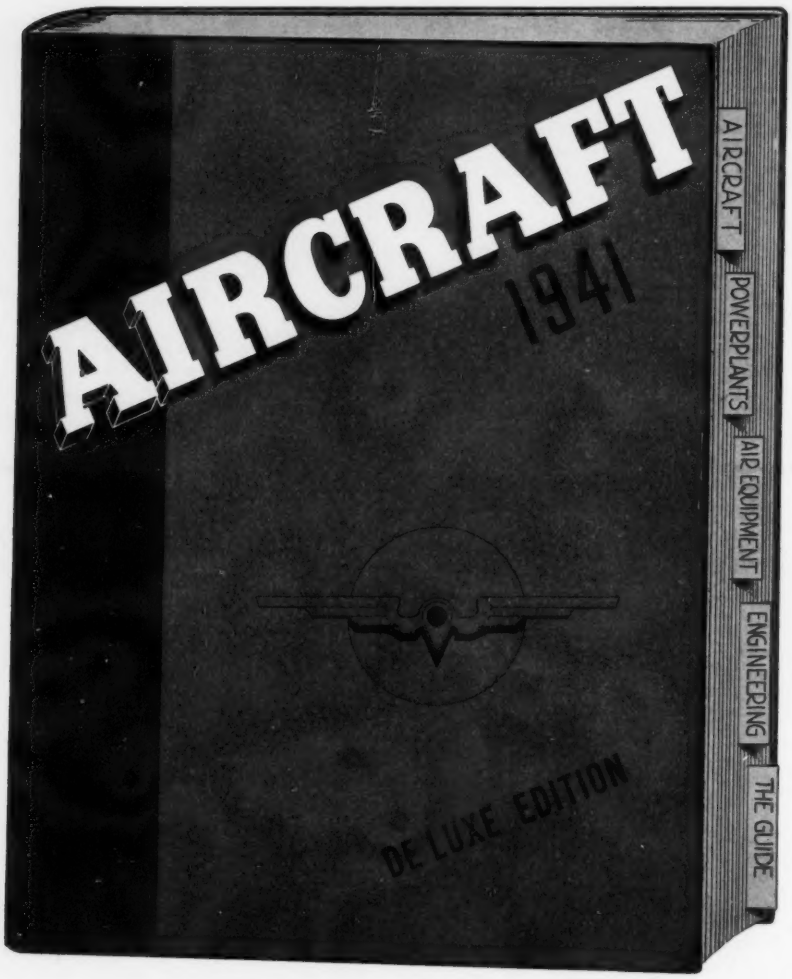
The Aviation Mechanic, by Carl Norcross and James D. Quinn; McGraw-Hill Book Company, Inc., New York, 1941; 563 pages, $3.50.

Prelude to Flight

For future service pilots rather than for private pilots, this book approaches flight instruction from the standpoint of general information of a wider interest than generally treated in books on the subject. A brief but thorough treatment is given the primary stages of aviation training. The discussion of military flying is accompanied by a chapter on "Combat" in which the author's own experiences in the Spanish Civil War afford a realistic background to the subject.

Production, airports, the mechanic and commercial flying are dealt with in their relation to flight training. The closing section, titled "Wings of Adventure," gives an account of the "ferry" flight of a bomber to Britain. The appendix contains a statement of the general requirements for appointment to American air services; a brief glossary of terms and bibliography are included.

So You're Going to Fly, by James L. H. Peck; Dodd, Mead & Company, New York 1941; 241 pages, $2.50.



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Hydraulics and Fluid Mechanics

Viewing fluid mechanics as the primary control or check on hydraulics, the author provides a concise, well-ordered study of the field of non-compressible fluids, which he considers already developed far beyond the capacity of the average American undergraduate. Omitting the usual opening discussion of the field and of the physical properties of fluids, the writer begins with cases where variations in viscosity have little effect, confining the quantitative study of viscosity to the last eight chapters.

The subject is handled *via* an historical approach, bearing forward from the pioneering work of Archimedes, Stevin, Torricelli and the Bernoulis to the developments of moderns such as Osborne Reynolds, L. Prandtl, Th. von Kármán and J. Nikuradse. The book is written as a complementary study of principles, rather than as a detail of the facts and rules of practice necessary in actual engineering work. Footnotes provide a guide to more complete treatment elsewhere. The many examples and problems are directed to facilitate computation rather than to simulate practice.

Mechanics of Fluids, by Ralph W. Powell; The Macmillan Company, New York, 1940; 271 pages, $3.50.

Engine Test Procedure

For a practical guide to engine testing, this manual undertakes a survey of the test procedures and systems used with various types of automotive engines, as developed and applied in a number of major industrial companies. Empirical data and abstractions are omitted except in so far as they bear on practical test experience, but important background is provided in the summary of thorough analytical research and accurate investigation. A comprehensive viewpoint of the main features of engine-testing is stressed throughout.

Engine-testing procedure and mechanical engineering fundamentals form an introductory framework for the practical data set forth. The subject is then treated in the order actually encountered by the test engineer: the construction and operation of the engine; the physical working media; the test laboratory and equipment plant; basic test calculations; actual test routine; analysis and evaluation of results and the determination of trouble sources.

Automotive Engine Testing, by F. M. Gruber; Pitman Publishing Corporation, New York, 1940; 441 pages, $4.75.

Aircraft Instrument Handbooks

Part of a mechanic's library compiled by a panel of experts under the title, *Aeroplane Maintenance and Operation Series*, these two books concern themselves with the theory, use and maintenance of the important aircraft instruments used in England and the United States. Although some of the trade names may not be familiar to American readers, the types of instruments have working principles in common with types used in this country.

Volume one gives a large amount of space to the history, principles, application and maintenance of the Sperry automatic pilot or "gyropilot" as the British call it. The study of servicing the gyropilot is remarkably thorough. The method for pre-flight and periodical checks is outlined and trouble-shooting directions for common faults are tabulated in a handy fault-and-remedy form. The Sperry Artificial Horizon and the Directional Gyro are handled in a similar manner.

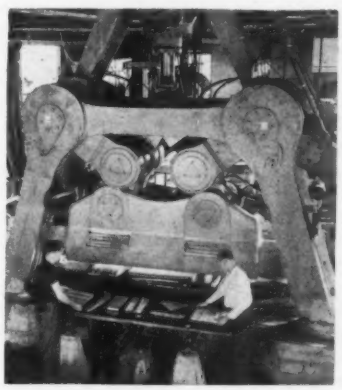
To assist the reader in checking on his knowledge of the foregoing material, a series of questions and answers were included which covered the Sperry material with surprising thoroughness.

Smith's Aircraft Instruments, British in origin, are similar in both theory and construction to common American-made instruments. Because of their simpler nature, they require less detailed treatment than the Sperry instruments. Electrical fuel gages, air speed indicator, altimeter, rate of climb indicator, tachometer, artificial horizon, turn and bank, various types of pressure gages and thermometers and warning signals are also explained.

The second part, published almost a year after the first, describes some of the newer instruments recently put into production in England. Some of the Kollsman series, well known in the U.S. are being built under license by Kelvin, Bottomly and Baird who also build instruments of their own design. The Kollsman sensitive altimeter and its installation and maintenance are explained. Other Kollsman instruments, also identical with American types, such as the simple altimeter, rate of climb indicator, accelerometer, heated pitot heads, electrical and magnetic tachometers, are likewise treated. The K.B.B. straight-away compass, similar to the other magnetic instruments is described, with placement directions which would be useful for any magnetic type. The K.B.B. Air Sight, a novel instrument designed on a simple trigonometric basis which enables the navigator to determine both his true ground speed and drift by sighting and timing, is introduced. The little maintenance which this device requires is outlined.

The remainder of the volume is devoted to the Smith Automatic Pilot, now widely used by the Royal Air Force, which, although it was designed to do essentially the same task as the Sperry gyropilot, differs from it in many ways. Unlike the Sperry, the Smith gyroscopes are motivated by compressed air as is the entire system. The general theory of gyro-motivated instruments is reviewed and the principles are applied to the Smith instrument. This is followed by a complete description of the Automatic pilot, its construction and operation, installation, adjustment, ground and air testing and an outline for correcting possible troubles in operation. The volume closes with a discussion of electric thermometers used in aircraft.

Airplane Instruments, E. Molloy, General Editor; Chemical Publishing Company, New York, Vol. 1, 1940, 128 pages, $2.00; Vol. 2, 1941, 128 pages, $2.00.



A new set of dies being arranged on the sliding table of a large toggle press at the North American Aviation, Inc., plant, while forming operations continue under the press. From *The Aviation Mechanic* by Carl Norcross and James D. Quinn, Jr.

Fluid Mechanics Test for Aircraft

Since high pressure hydraulics systems are serving an increasing number of functions in modern airplanes, an expanded knowledge of the principles and application of fluid mechanics is essential for both pilots and mechanics. This text was designed for the practical mechanic as a reference book and for the use of students in conjunction with supervised study.

The subject is introduced by preliminary examination of the primary theory of hydraulics, including the study of fluid energy, the application of Bernoulli's theorem and such necessary mathematics as Chezzy's formula, Reynolds Number and the use of instruments for measuring viscosity. Attention is also given to pressure losses in lines due to bends and fittings.

Proceeding with accounts of the stresses affecting hydraulic parts, the buckling of tubes and similar problems, this primary physics is applied to actual devices. These principles are then applied to systems in regular use, such as the automatic pilot, various types of hydraulically operated controllable pitch propellers, fuel and oil selector systems, controls, retractable undercarriages, shock struts, etc.

A valuable section of this book is the chapter on hydraulic systems of transport aircraft written from the pilot's viewpoint rather than that of the mechanic or designer. It furnishes instructions and precautions on the operation of the fluid system in the average twin-engined transport. Along with instructions for operation during normal flight, suggestions are given for emergencies: what to do if a landing gear safety latch fails, if line or pressure tank failure occurs, if a fuel pump drive or vain fails or other parts of the complex system go out of order. Special precautions are offered for guarding against abuse of the delicate hydraulic systems of the automatic pilot.

Final pages present an examination of miscellaneous hydraulic equipment, such as shock absorbers and remote controls, and a discussion of maintenance, fluids, excessive pressures and packing systems. As a whole, this book is compact in treatment and depends heavily on its simple diagrams for explanation. It is printed by offset to facilitate quick revision in view of the rapid changes occurring in this phase of aircraft design, construction and operation.

Aircraft Hydraulic Systems, by E. W. McDonough; The Aircraft Specialties Co., Chicago, 1940; 78 pages, $2.50.

Elementary Navigation Workbook

To assist instructors and students in developing a facility for quick, accurate computation under flying conditions, this booklet sets forth in progressive order a series of exercises in elementary air navigation. The method of working out the examples is optional, but the suggestion is made that a degree of accuracy be sought such as would be practicably useful. Answers are in a form to permit checking calculations in successive stages.

Numerical Examples in Elementary Air Navigation, by G. K. Clatworthy; Pitman Publishing Corporation, New York, 1940; 52 pages, $1.20.

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Machinists' Handbook

This book is designed to provide a reference text for practicing machinists who hope to become tool makers, and a student's text book for those who are training to become machinists. The study of machines in common use systematically presents a description of each machine, its construction and operation and the various machining operations it performs.

Opening with a review of machine shop practice, the study entails such primary considerations as shop measuring tools, their function and use, the art of measuring, the use of these instruments in laying out work and the characteristics of common materials.

Heat treating equipment and procedures, and their use in annealing, hardening and tempering are described. The equipment and principles of bench work as well as their practical applications are examined. Much space is given to the construction, function and use of lathes, and attention is drawn to the wide variety of work that can be done on the "king of tools." Taps, dies and reamers are explained together with drills and drilling machines of various kinds. Lengthy treatment is given to horizontal and vertical boring machines, slotters, shapers and milling machines, their various tools, arbors, cutters and adapters as well as to special tools for particular jobs.

The latter part of the text undertakes to examine free-hand drawing, blueprint reading and the various types of mathematics required for the tool maker and machinist. A primary study of shop physics and directions for use of the slide rule complete this comprehensive and useful handbook.

Audels Machinists and Tool Makers' Handy Book, by Frank D. Graham; Theo. Audel & Co., New York, 1941; 1602 pages, $4.00.

Early Bird Meanders

The Early Birds will be interested in reading the sketchy biography of one of their members whose flying career apparently ended when she married P. Hal Sims, the well-known bridge player. Her early experiences at Mineola and with Lawrence Sperry are related in a gay spirit and show that she had a great time while it lasted. The book carries her career forward with impressions of many well-known celebrities and is written with a blunt disregard for conventionalities.

Curiouser and Curiouser, by Dorothy Rice Sims; Simon and Schuster, New York, 1940; 203 pages, $2.00.

Put these books on your calendar for National Defense—

Armament Production Polices. Official Record of a Question and Answer forum held by The New York Post of the Army Ordnance Association, pertaining to defense work procurement, production, profit and taxes—for Industrial Executives and Engineers. 1941—57 pages. $1.00.

Silver in Industry. Edited by Lawrence Addicks. 1940. 636 pages. $10.00.

Catalysis—Inorganic and Organic. By Sophia Berkman, Jacque C. Morrell and Gustav Egloff. 1940. 1150 pages. $18.00.

The Chemistry of Synthetic Resins. By Carleton Ellis. (In two volumes) 1935. 1615 pages. $19.50.

Uses and Applications of Chemicals and Related Materials. By Thomas C. Gregory. 1939. 653 pages. $10.00.

Industrial Solvents. By Ibert Mellan. 1939. 487 pages. $11.00.

Beryllium: Its Production and Application. By Siemens-Konzerns. Trans. by R. Rimbach and A. J. Michel. 1932. 331 pages. $10.00.

The Condensed Chemical Dictionary. Edited by Francis M. Turner. 2nd Edition, 1930. 522 pages. $10.00.

The Chemistry and Technology of Rubber. By Carroll C. Davis and John T. Blake. 1937. 941 pages. $15.00.

Lubricating Greases: Their Manufacture and Use. By E. N. Klemgard. 1937. 873 pages. $15.00.

The Properties of Glass. By George W. Morey. 1938. 561 pages. $12.50.

Casein and Its Industrial Applications. By Edwin Sutermeister and Frederick L. Browne. 2nd Edition. 1939. 433 pages. $6.50.

Modern Practice in Leather Manufacfacture. By John A. Wilson. 1941. 744 pages. $9.50.

Protective Coatings for Metals. By R. M. Burns and A. E. Schuh. 1939. 407 pages. $6.50.

Chemistry of Petroleum Derivatives. By Carleton Ellis.
Volume I. 1934. 1285 pages. $18.00
Volume II. 1937. 1464 pages. $20.00

Conversion of Petroleum. By A. N. Sachanen. 1940. 413 pages. $6.00.

Corrosion Resistance of Metals and Alloys. By Robert J. McKay and Robert Worthington. 1936. 500 pages. $7.00.

Modern Methods of Refining Lubricating Oils. By V. A. Kalichevsky. 1938. 240 pages. $6.00.

Industrial Chemistry. By E. R. Riegel. 3rd Edition. 1937. 830 pages. $5.75.

REINHOLD PUBLISHING CORP.
330 W. 42nd St. New York, N.Y.

Air Post

The first of two standard stamp catalogues is subtitled "The Encyclopedia of Philately." The companion volume is concerned wholly with air post. The comprehensive book lists the principal air mail stamps of various countries, but it contains less descriptive matter regarding the issues than is found in the specialized catalogue. One is for the general collector, the other for the specialist in the one field.

The American Air Mail Society collaborated in the preparation of the Air Post Edition which will be published annually hereafter. While the book is not claimed to completely cover the field, it is an initial step, and will serve a useful purpose. The prices given represent what may be considered by dealers a proper normal price basis. A listing of new issues will appear monthly in the *Airpost Journal*.

Scott's Standard Postage Stamp Catalogue; Scott Publications, Inc., New York, 1941; 1543 pages, $3.00.

Scott's Standard Catalogue of Air Post Stamps; Scott Publications, Inc., New York, 1941; 228 pages, $2.00.

Vector Analysis

An introduction to the principles of vector analysis handled from a physical viewpoint. It is not intended for those with purely mathematical interests, since their more rigorous and systematic requirements are fully met elsewhere. The approach to the subject being physical, geometrical matters and other exclusively mathematical elements are limited to essentials. Purely analytical topics are justifiably omitted.

Attention is drawn to two features of the book: the explanation of the trimetric projection by Gough's method for certain three-dimensional diagrams, and the inclusion of a chapter on the elementary properties of tensors and dyadics in their relation to vectors.

An Introduction to Vector Analysis, by B. Hague; Chemical Publishing Company, New York, 1941; 118 pages, $1.50.

Navigator's Primer

Written expressly for the student pilot, this book on the ABC's of compass navigation deals with the subject in its simplest form. It is a study of compass anatomy and adjustment, and of cross-country flying by compass and auxiliary instruments. The subject is broached by examining the nature of magnetism and magnetic attraction, and the manner by which these natural laws are harnessed in the magnetic compass. The structure of common types of liquid compasses and how they are read, deviation and its causes and the mechanics of adjusting or "swinging" a compass are given much attention.

The application of the compass in actual cross-country flying is illustrated, and the elements of map reading are presented. Directions are given for setting a course, allowing for deviation, variation, wind, etc.; also for the use of drift indicators in conjunction with the compass. Final sections deal with the application of the foregoing principles to practical problems in flight over unknown country and over water.

Simplified Aerial Navigation by Dead Reckoning, by J. A. McMullen; Chemical Publishing Company, New York, 1941; 96 pages, $2.00.

Mathematics in Engineering

An introductory treatment to a subject of great interest to engineers doing research work in the field of theoretical aerodynamics or elasticity is presented in this book. It gives the engineer and student a conception of the theory of orthogonal sets of functions and their application to the solution of problems in physical sciences. It also shows how boundary layer problems in partial differential equations can be solved with the aid of those expansions in series of orthogonal functions.

The style emphasizes rigorous mathematical proofs but Professor Churchill's approach to the problem is always that of an engineer mainly interested in getting an answer to a physical rather than mathematical problem. Mathematical methods and concepts are developed and explained from the viewpoint of their application to the solution of boundary value problems in the partial differential equations of physics and engineering. In this respect the book parallels "Mathematical Methods in Engineering" by von Kármán and Biot although its system of presentation is different. It also complements the latter book which does not deal with partial differential equations.

Topics such as the partial differential equations of physics, orthogonal sets of functions, Fourier series and integrals and their application to the solution of boundary value problems, uniqueness of solutions, Bessel functions and applications, Legendre polynomials and applications, are presented. This material is a revision and extension of notes used in a course given for many years by the author at the University of Michigan to students of physics, mathematics and engineering who have had an introductory course in ordinary differential equations and one semester of advanced calculus. As reference and review problems usually form an essential part of a college text, a wide variety of problems with answers are given.

While this work meets the growing needs of engineers and students interested in the application of mathematics to physics and engineering, its treatment is also suited to the student of pure mathematics as every proof is completely covered.

Fourier Series and Boundary Value Problems, by Ruel V. Churchill; McGraw-Hill Book Company, Inc., New York, 1941; 206 pages, $2.50.

Electricity for Airplanes

The increase in size and function of the modern airplane with its radio, lighting, ignition systems and miscellaneous other electrical appliances has created many peculiar problems in electrical installation. This volume was planned to aid in the training of men for this particular type of installation and design. It first introduces the ordinary primary electrical study, explaining theories on its nature and characteristics and presenting the common mathematics of electricity.

It is essential that the electrician wiring an airplane make intelligent use of wiring diagrams without additional information from engineers or draftsmen. Most of the commonly used symbols for devices and connections are used, being adopted wherever possible from common electrical terminology. Wiring diagrams for common electrical devices used in aircraft, such as fuel analyzers, flowmeters, synchroscopes, etc., are provided.

The drawing and interpretation of actual wiring diagram is discussed in detail with an account of the use of common conduit, shielded cables and special aircraft connectors. The theory and use of bonding, a special aircraft problem, and ignition shielding for radio are well covered. Reference charts and tables commonly used by aircraft electricians in their daily work conclude the book.

Aircraft Electricity, by Norman J. Clark and Howard E. Corbitt; The Ronald Press, New York, 1941; 184 pages, $2.50.

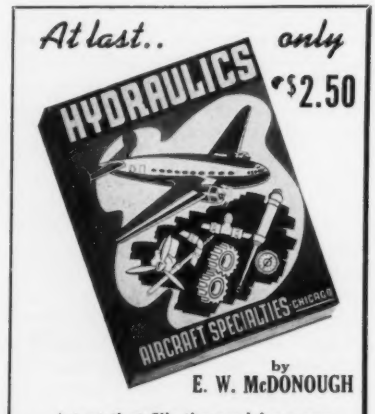
Model Power Plant Engineering

The increased use of small gasoline engines for model airplanes, racing cars and power boats has created a real science in the design, maintenance and selection of these tiny power plants. Already, their manufacture has become a fair-sized industry. This book on model gas engines, their operation and use, opens with an outline of the history of all internal combustion engines. The two-and four-cycle principles are explained. The peculiar characteristics of the two-cycle principle which make it usable for these flyweight engines are emphasized.

In explaining the principles of carburetion and ignition, their application to practical model maintenance is immediately indicated, although the general principles applied to all power plants are presented.

The study of operation of these two-cycle units brings out many of the unusual problems such as lubrication and special high-powered fuels, special ignition tricks and stock methods for improving power delivery. A considerable amount of space is devoted to desirable characteristics in power-plant design and construction for which the buyer should look before purchasing a motor. Many of the standard makes now on the market are discussed. The installation of these power plants in airplane, boat, and automobile models is treated, and the final chapter is given to radio-controlled airplane models and to the construction of apparatus for successful remote-control operation.

Model Gasoline Engines, by Raymond F. Yates; D. Appleton-Century, Inc., New York, 1941; 241 pages, $2.50.



A text that fills the need for a comprehensive explanation of this highly specialized branch of aeronautics. This excellent work explains elementary hydraulic theory, power transmission, friction, weight and strength analysis. It contains practical information for pilots and mechanics on operation, testing, and maintenance of transport hydraulic systems, illustrating and describing the complete system. For all who wish to advance in aeronautics here is information on the mechanics of the airplane which you cannot possibly afford to be without!

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AIRCRAFT SPECIALTIES 134 So. Waller Ave. Chicago, Ill.

Plastics

Although no direct reference is made to the application of plastics to aircraft, the increased use of plastics makes a knowledge of their history, chemistry, application, handling and use, of interest to airplane designers and builders.

The first plastics, it is pointed out, were the daubs of water-soaked clay with which prehistoric man made his first sun dried pots and containers. This process was later refined, the clay was fired and the potter's wheel invented, but the basic material was still earth. Glass came next, only to be lost and rediscovered.

The need for a solid, moldable insulating material for use in electrical research brought forth ebonite, a rubber-base plastic. This was followed by pitch and bituminous products, rubber-asbestos mixtures, etc. Phenol-formaldehyde resins began with Dr. Baekeland and Bakelite.

Chemical and physical properties of various types of modern plastics are discussed as well as the raw materials from which they are made. The various processes by which their components are mixed and molded are described. Particular attention is given modern equipment, inspection and testing, and a survey is made of possible increased uses of plastics in the future.

The Making and Moulding of Plastics, by L. T. M. Bell; Chemical Publishing Co., Inc., New York, 1938; 242 pages, $5.00.

A.R.P. Bulletins Reprinted

Ten of the important pamphlets on air raid precautions and passive defenses against air attack, originally printed by His Brittanic Majesty's Stationery Office, have been collected into one volume for American use. Having been written separately, they retain their individual identity in the reprint, but overlap in subject matter where necessary for the individual section.

The first bulletin deals with the organization, equipment and training of rescue parties, whose work it is to extricate casualties from bomb-damaged buildings and to demolish damaged structures menacing to safety. Another section outlines the organization of decontamination units whose operations neutralize the effect of persistent blister gases such as mustard, which lingers on the surfaces of streets, buildings and even vehicles.

The pamphlet on structural defenses describes the nature of air attacks and high explosives, and their effect and penetration as well as the manner in which different types of bombs are built and used. The principles of design involved in the construction of bomb-proof shelters reveal interesting data on materials and designs in comparison to theories set forth by the French, Swiss, Italians and Germans. The ideal concrete mixture for bomb shelters and requirements in size, ventilation, entrances and emergency exits are also discussed.

In modern warfare, it is necessary for general military headquarters to receive and disseminate information on casualties and damage. The plan for such an organization, the manner in which reports are handled, transmitted and, when necessary, circulated are outlined. Other sections treat of such information as the accepted routine for the training and exercise of A.R.P. personnel, gas detection and identification, the protection of windows in factories and commercial buildings, as well as the maintenance of gas masks, oilskin garments and other A.R.P. equipment.

Air Raid Precautions; Chemical Publishing Company, New York, 1941; 269 pages, $3.00.

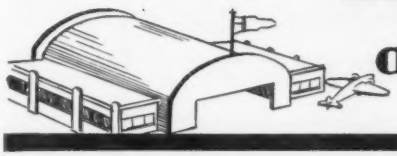
Aid to License Applicants

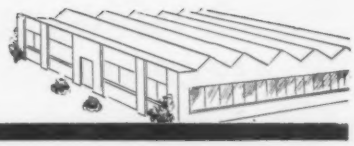
As a revision of "Transport Examiner," mimeographed question-and-answer booklet published by the author in 1936, "Aeronautics Simplified" brings up to date the original manual for students facing examination for pilots' licenses.

The style of the first manual is retained; the addition of illustrations heightens the text and the inclusion of a glossary of terms provides ready reference. The answers to questions are so written as to emphasize essential points easily overlooked in reading the questions. In covering the entire scope of the examination, from the airplane itself to air traffic rules, simple and logical explanations and definitions are offered in preference to a technical or theoretical approach.

Aeronautics Simplified, by Lt. Ernest G. Vetter, U.S. Naval Reserve; Foster & Stewart, Buffalo, 1940; 172 pages, $1.50.

House Organs and Catalogues





The Story of Aluminum

An Outline of Aluminum. A brief review of the development, characteristics and use of aluminum. It begins with an account of the discovery of the metal by Hans Christian Oersted of Denmark in 1825, its further development by Wohler and Deville and the final discovery of the electrolytic method of extraction by Charles M. Hall in Oberlin, Ohio, and Paul Louis Toussaint Heroult in France. The availability of raw material, the procedure in mining it and the commercial process for extracting the metal from the ore are detailed.

A description is given of the methods whereby aluminum and its alloys are fabricated and shaped into sheet, tube, wire, extrusions and castings; how it is welded, stamped, turned, milled and riveted. The physical and chemical properties of aluminum are noted to show how they qualify the metal for specific tasks. *Aluminum Company of America.*

Light Airplanes for Artillery Direction

Calling All Light Planes. Major William W. Ford. The writer, a U.S. field artillery officer, states that light airplanes flown by private C.A.A. pilots could be of great military value as part of a basic fire unit carrying artillery observers. The light airplanes, equipped with two-way radio, could be operated out of fields which no regulation observation type could use. The craft would be protected by camouflage as well as by the fact that enemy fighters would have to fly within range of ground defenses to attack them. The extreme maneuverability of the light plane and the relative shortness of the flights necessary for operation would also be in their favor. *A.O.P.A. Section,* June.

Nickel Alloys in Light Aircraft

Cubs Now Roll by Hundreds from Mile-Long Assembly Line. In 1931, the total production of Piper Cubs was 24 airplanes. Last year, 45 per cent of the total number of aircraft built in the U.S. came off Piper Aircraft's production line at Lock Haven, Pa. The use of *Nicral,* a light-weight aluminum alloy containing 2 per cent nickel, for the wing ribs, cap strips and other wing parts, has not only saved weight and increased strength, but it has also saved two hours in the construction of each airplane. In the engine and other parts of the Cub, nickel alloys increase strength and wear-resistance. This article indicates the important parts of the Cub for which nickel alloys are being used. *Inco,* April.

Weldwood Shear Test

An account of a series of tests conducted by engineers of the Spencer-Larsen Aircraft Corp. to determine the shear strength of Weldwood Glue joints on different wood combinations, such as spruce glued to mahogany, spruce to spruce, mahogany to mahogany and pine to mahogany. Three samples of each combination were tested, the wood being glued so that the grains would be parallel to the lines of force. In all of the tests, wood failure occurred but no sign of glue failure was encountered.

Similar tests were then conducted on Weldwood joints soaked in water, adding this time a sample of pine glued to pine. The specimens were immersed in sea water for 24 hours and permitted to dry for 12 hours; the soaking was repeated in fresh water and the specimen dried for a similar time. Then they were again soaked in sea water for 24 hours and tested while wet. The shear load was applied again. The results indicated that the immersion did not impair the strength of the joint. *U. S. Plywood Corporation.*

Accelerated Service Tests

The Airacobras Can Take It. An account of the recent service tests on the Bell P-39 conducted at Patterson Field from February 12 to March 21. Twenty-seven pilots from Selfridge, Wright and Patterson Fields put three Airacobras through all known fighting maneuvers under the most grueling conditions in order to reveal any weaknesses the airplanes might have inherently or might develop during service. After more than 160 hours of strenuous flying, the three airplanes showed no signs of deterioration and were sent to Selfridge Field for active service. *The Bellringer,* May.

Production Instruments

Toolmaker Microscope. An 8-page folder containing a full description of the design and applications of the Toolmaker Microscope. As an aid to efficient production, it is particularly adaptable to tool and part inspection and to length, coordinate, angle and thread measurements. Specifications, photographs and section-diagrams illustrate the instrument and its uses.

Chronographs and Time Standards. In a 24-page catalogue, tape and drum chronographs, tuning forks and regulator clocks are presented with photographs, descriptive text and specifications. The operation and application of the instruments are explained. *The Gaertner Scientific Corporation.*

Cadet Brochure

Folder explaining the construction and performance of the Interstate Cadet, a two-place, high-wing tandem trainer powered by either Franklin or Continental 65-hp. engines. *Interstate Aircraft & Engineering Corp.,* El Segundo, Calif.

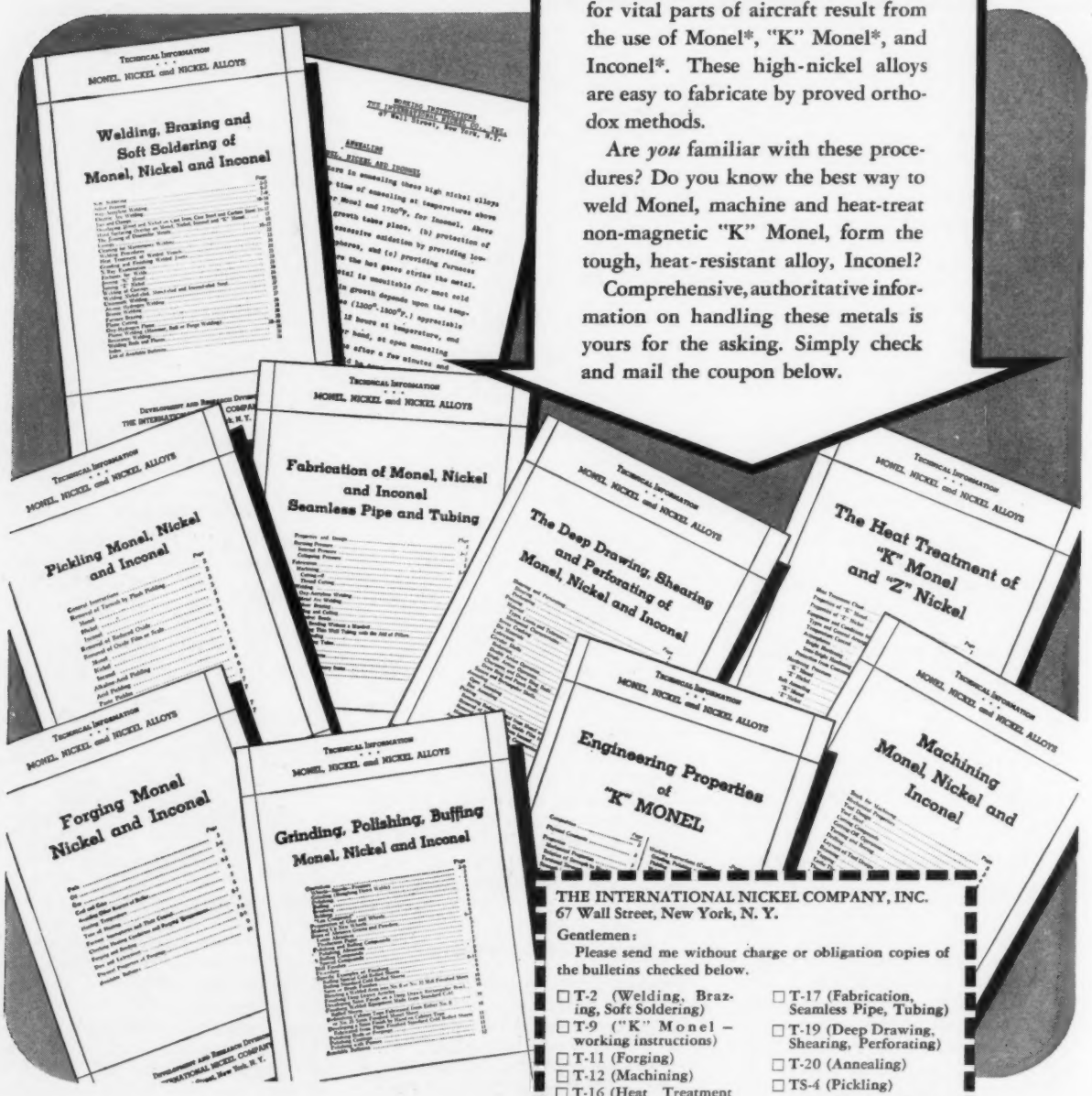
Airplanes from Auto Plants

Airplanes by Fisher—in 1918 They Built 2,000. In an interview, Ed Fisher of the Fisher Body Division of General Motors Corporation compares production conditions of today with those of 1918. In that year his company switched from car body to training airplane production on extremely short notice. First, the Fisher Company built J1 trainers, then American versions of the DH4 and conversions of the Caproni twin-engined bombers and Le Pere fighters. The difference in material, procedure, craftmanship and productive problems is noted. *North American Skyline,* April.

Engine Developments

Engines Keep Them Flying. Army Air Corps research experts at Wright Field are already looking forward to airplane power plants delivering four times the power of today's 2,000-hp. engines. The latter are now being used on the nation's newest warplanes, and engineers believe it is not fantastic to

How to Fabricate
3 IMPORTANT AIRCRAFT METALS...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hope that 8,000-hp. engines will eventually go on the test stands for the rigorous acceptance tests which all new engines must pass before approval for service in Army aircraft.

New Power plant test equipment now being assembled at Wright Field has been designed with this goal in view, and when the big engines are ready, this equipment will be heavy and strong enough to perform the necessary tests.

In this article, the development of American airplane engines is briefly traced from the first Wright flight in 1909 down to the present. The objective of Air Corps research engineers in cooperation with engine manufacturers is to develop aviation engines with a maximum power for each pound of weight, and with high standards of dependability, durability and economy. *The Air Corps News Letter*, April 1.

On Welding Aluminum

Welding Aluminum and Its Alloys. A handbook on the welding of aluminum and its alloys by various methods. Written in simple language, it explains the problems and procedures for both torch and arc fusions. The use of gas welding, the types of materials, apparatus, torches, tips, etc., are presented. Also outlined are the relation of the tip sizes to gas pressure, the criterion for adjusting flame, the use and selection of flux, the choice of welding wire and the method of cleaning and finishing welds.

The procedures in setting up welds in aluminum vessels, for torch welding and heat-treating alloys, and for unions in castings are also given.

Arc welding is handled with similar thoroughness. Arc characteristics, the use of jigs and electrode manipulation are among the topics discussed. Spot and seam welding are also treated at length. *Aluminum Company of America.*

New Spartan Catalogue

The 1941 edition of the student's catalogue of the Spartan School of Aeronautics. This brochure indicates the future opportunities for trained men in aviation and describes the school and its facilities. An outline is given of the courses of instruction and the various types of training offered. *Spartan School of Aeronautics*, Tulsa, Oklahoma.

Civil Pilot Training

Hinckley's Reply to 28 Questions. The official replies to 28 questions on Civilian Pilot Training procedure and policies, directed to C.A.A. officials by National Aviation Training Association spokesmen and answered by Robert H. Hinckley, Assistant Secretary of Commerce. *The N.A.T.A. Climb*, April.

Cobras in Action

A day with the men of the 39th Pursuit Squadron at Selfridge Field. This squadron, part of the 31st Pursuit Group, is equipped with Bell P-39's. This article describes the daily workout this group gives the Airacobras and the variety of military missions assigned to this group in order to keep both airplanes and men in prime fighting condition. *The Bellringer*, May.

The Story of Dowmetal

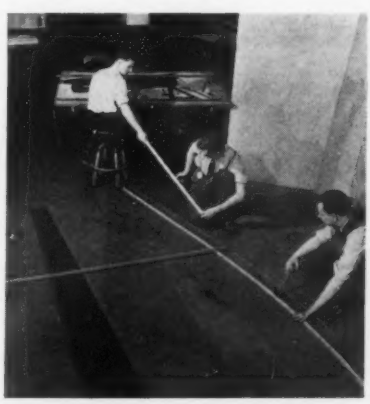
Industry's Lightest Structural Metal. An interesting and profusely illustrated booklet on the history, uses and production of Dowmetal, a magnesium-based, light metal alloy now being widely used in aircraft construction. The third most abundant metal, magnesium exists nowhere on the earth's surface in a free state. It was first extracted in 1830 and remained for years a laboratory curiosity. Characterized by extreme lightness, magnesium alloys serve many functions requiring savings in weight.

Tabulated lists of the alloy's characteristics, composition and properties are provided together with a description of the thicknesses and extrusions in which the alloy stock is available.

Common methods of forging, machining, forming and welding of Dowmetal are given in detail. *The Dow Chemical Company.*

Automatic Direction Finder

Learadio ADF8. A technical brochure describing the design, construction and use of the Learadio ADF8 Automatic Direction Finder. It contains a clear, graphic explanation of how the set is used in flight; two problems in radio navigation are worked out. Technical details such as the equipment, dimensions, coverage output and power consumption are also provided. *Lear Avia, Inc.*, 20 pages.



The Mold Loft at the Curtiss-Wright plant at Buffalo, N. Y. The design engineer's sketches are laid down in full scale and balanced so that they become aerodynamically smooth, blending with all other units of the airplane. These lines become the "body plan" used by the drafting room for determining parts and for making all tool layouts or templates and patterns.

New Guerin Press for Douglas

Pressure for Defense. A new type of hydraulic press, designed to accelerate the forming of airplane parts, is being built for Douglas by the E. W. Bliss Company. Designed by Earl Cannon, hydraulic engineer, the new 2,500-ton-capacity units will have six sides, thus providing a greater selectivity and less time loss in changing dies. The application of this press to the Guerin process is expected to aid Douglas in breaking production records in their new "blackout" plant at Long Beach. *Douglas Airview*, April.

Metal Shortage

The War of Metals. Walter Mitchell, Jr. A pamphlet of 11 pages, containing a discussion of metal shortage and the application of priorities as they affect manufacturing, distribution and civilian use. A list of examples of successful substitutions and a classified summary of the priorities critical list are presented. Pie-charts are used to show the normal character of aluminum, zinc, nickel, copper, tin and lead consumption by various industries. *Dun & Bradstreet.*

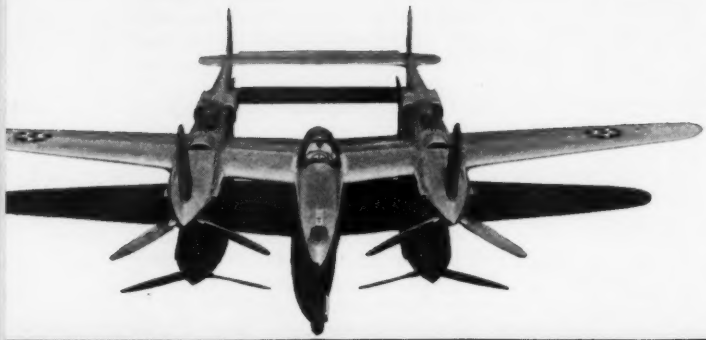
New Aeronca Brochure

A new folder describing the improvements over last year's model of the Aeronca Super Chief. Among new additions to passenger comfort are wider adjustable seats, centralized control panel, improved soundproofing in the cabin, and temperature control, as well as increased visibility, speed and cruising range. *Aeronautical Corporation of America.*

Facts on Aluminum

The Use of Aluminum in Aircraft. R. L. Fitch. A history of aluminum from the first reference to it in the records of the historian, Paracelsus. Figures are presented on the amount of Bauxite, coal, Cryolite, caustic soda and other materials required for the extraction of aluminum on a commercial basis. A description of the various alloys is also provided, together with an interpretation of the letter and number designations for the various compositions and treatments of the commercial metal. The different heat treatments for aluminum alloys are outlined and special precautions against inter-granular corrosion and other deterioration are suggested. *The Norcrafter*, April.

Tough customer



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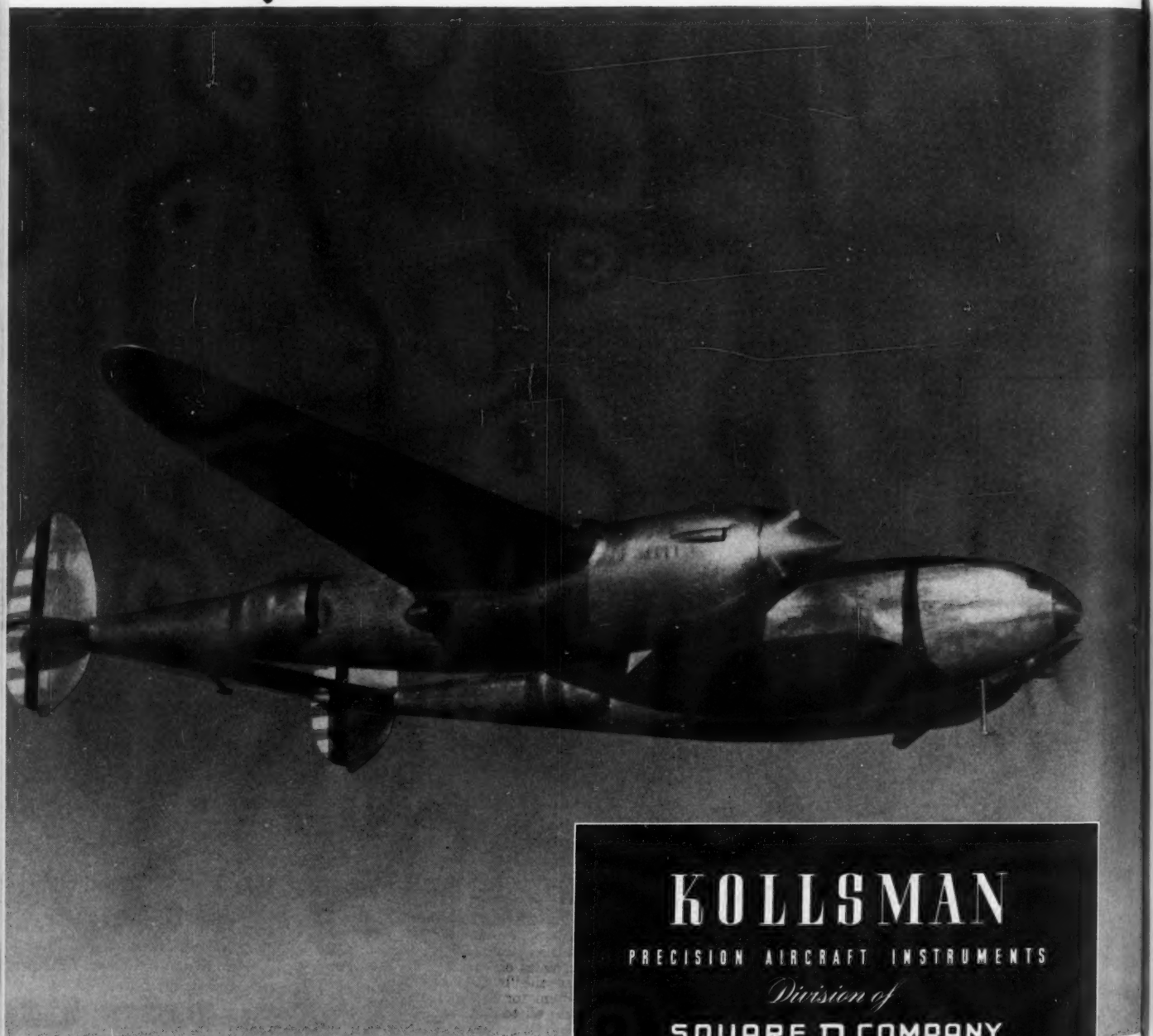
Instruments *can not* fail. They *must* transmit their vital messages instantly—reliably—*precisely!*

No wonder our government, and Great Britain's, are "tough customers" in buying instruments for such planes.

Instruments, too, have to be tough. Though made with metals sensitive as nerves, Kollsman Precision Instruments can "take it"!



This is the new YP38 Lockheed Interceptor-pursuit plane. Like its famous co-warrior, the Kollsman-equipped Lockheed Hudson Bomber, this plane will soon be fighting for Britain.

IT PAYS TO **FLY**

KOLLSMAN

PRECISION AIRCRAFT INSTRUMENTS

Division of

SQUARE D COMPANY

ELMHURST, NEW YORK • GLENDALE, CALIFORNIA
DETROIT, MICHIGAN

Britain Also Uses Parachutists

Parachute and Airborne Troops. While Leonardo da Vinci indicated the possibility of parachute invasion almost five centuries ago, it wasn't until the Russians began experimenting with mass troop descents in 1930 that the technique was given serious consideration. This article outlines the history and progress of the active military application of parachute troops, indicating the functions of these battalions. A description is given of the recent expedition against Southern Italy by British parachutists. *London Calling*, May.

Aluminum Riveter's Handbook

Riveting Aluminum and Its Alloys. As a workman's guide in the art of riveting aluminum, this pamphlet omits complicated engineering terminology and carefully explains those uncommon terms which are unavoidable. The simple formulas which are essential to every riveter—those concerning shear failure, bearing failure, ultimate load, etc.—are broken down, their components explained and their functions demonstrated in terms of common practice.

The best methods of riveting, selecting rivets of proper size and length, placing them at proper intervals and at a correct distance from the edge are outlined. The text also prescribes the method for determining the pressure required to drive rivets and the best way to place and buck them.

Special attention is given to the riveting problems peculiar to aviation, particularly to those unions that are to be exposed to salt water. Commonly used work tables are also provided. *Aluminum Company of America.*

A Study of Stalls

Stall and Associated Air Speeds. John L. Magden. A pilot's study of the relation of air speed and aircraft attitude to stalls. It is pointed out that there are still many pilots who believe that aircraft will stall at the same indicated speed regardless of attitude. The writer indicates that it is the angle of attack, not the indicated speed, that determines the stalling point. The snap-roll performed at 140 m.p.h. in a craft with a 60-m.p.h. landing speed is offered as proof. The effect of icing on the stall characteristics of aircraft is also discussed. *Air Line Pilot*, February.

Miracles of Chemistry

Werkstoffe. Karl Dorn. A pamphlet issued by the Germany Library of Information reviews the purported successes of German scientists in the creation of *ersatz*, or synthetic products. Among the common products which have emanated from the German chemist's laboratory and are discussed here are synthetic fibers, plastics, laminated synthetic products, rubber-like materials, Buna and various metals and alloys. The source of these *Werkstoffe* (materials) and their applications, both common and potential, are described in brief. *German Library of Information.*

Magnetic Compass

Direction Indicator. Supplement No. 2 of the *Kollsman Handbook of Airplane Instruments* describes the Kollsman direction indicator apparatus and gives directions for its use, repair and adjustment. The direction indicator is radically different from the conventional compass in design and operation as shown by the diagrams and descriptions in this 16-page catalogue section. *Square D Company.*

Light Relay

The Sun-Switch, a new photo-electric relay for lighting and power, has been announced by the United Cinephone Corporation of Torrington, Conn. The switch is used to control electric circuits in accordance with the rise and fall of natural illumination. The user chooses two lighting levels at which he wishes the load switched on and off, and adjusts the calibration dials to the corresponding foot candle levels. Operation is entirely automatic, no resetting being necessary. It is primarily designed as an aid to greater safety and economy in incandescent lighting applications. Important advantages result from this device in this service, including: (1) Lighting when it is needed, regardless of when darkness comes. (2) Lighting turned off when the presence of sufficient daylight makes it unnecessary. (3) The lighting job will be done automatically.

Dimensions of the unit are $10^{3}/_{4}$ in. $\times$ $5^{3}/_{8}$ in. $\times$ $3^{1}/_{2}$ in. The control circuit uses a type 921 photo-tube, having a life expectancy of 20,000 hours and two type 6J5 tubes having a life expectancy of 5,000 hours each. Operation is from 110 volts, 50 or 60 cycles, alternating current. *United Cinephone Corp.*

Light In-Line Engine

A specification sheet on the Skymotor Model 70A, 60 hp., air-cooled engine. It is an inverted, four-cylinder-in-line motor. This lightplane power plant weighs 178 lbs. dry, including dual ignition, rubber motor supports, air-cooling scoops, carburetor and manifold. It is 29 in. high and measures 18 in. over-all width across the magnetos. *Skymotors, Inc.*, Milwaukee.

General Aluminum Handbook

Aluminum and Its Alloys. A comprehensive study of aluminum and its alloys is presented in this handbook in order to furnish the designing engineer with information needed in choosing the proper alloy for specific tasks. The introduction gives information on aluminum itself, its sources, extraction and history.

The handling of wrought alloys is carefully considered. A detailed study is made of temper and temper designation, the choice of alloys for specific handling and the use of heat-treatable and non-heat-treatable alloys. Other wrought products, Alcald, forgings, extrusions and screw machine products, and the standard methods for heat-treating aluminum alloys are also examined.

Various types of casting procedures in common use are reviewed, naming the alloy that best lends itself to each method. Fabrication processes such as hot and cold forming, welding, brazing, riveting and machining are handled in a like manner. The text is supplemented by tabulated information on standard commodities, bending radii, chemical composition, general and mechanical properties, commercial sizes and tolerances and similar data universally used by designers. *Aluminum Company of America.*

Folio on Conduit and Fittings

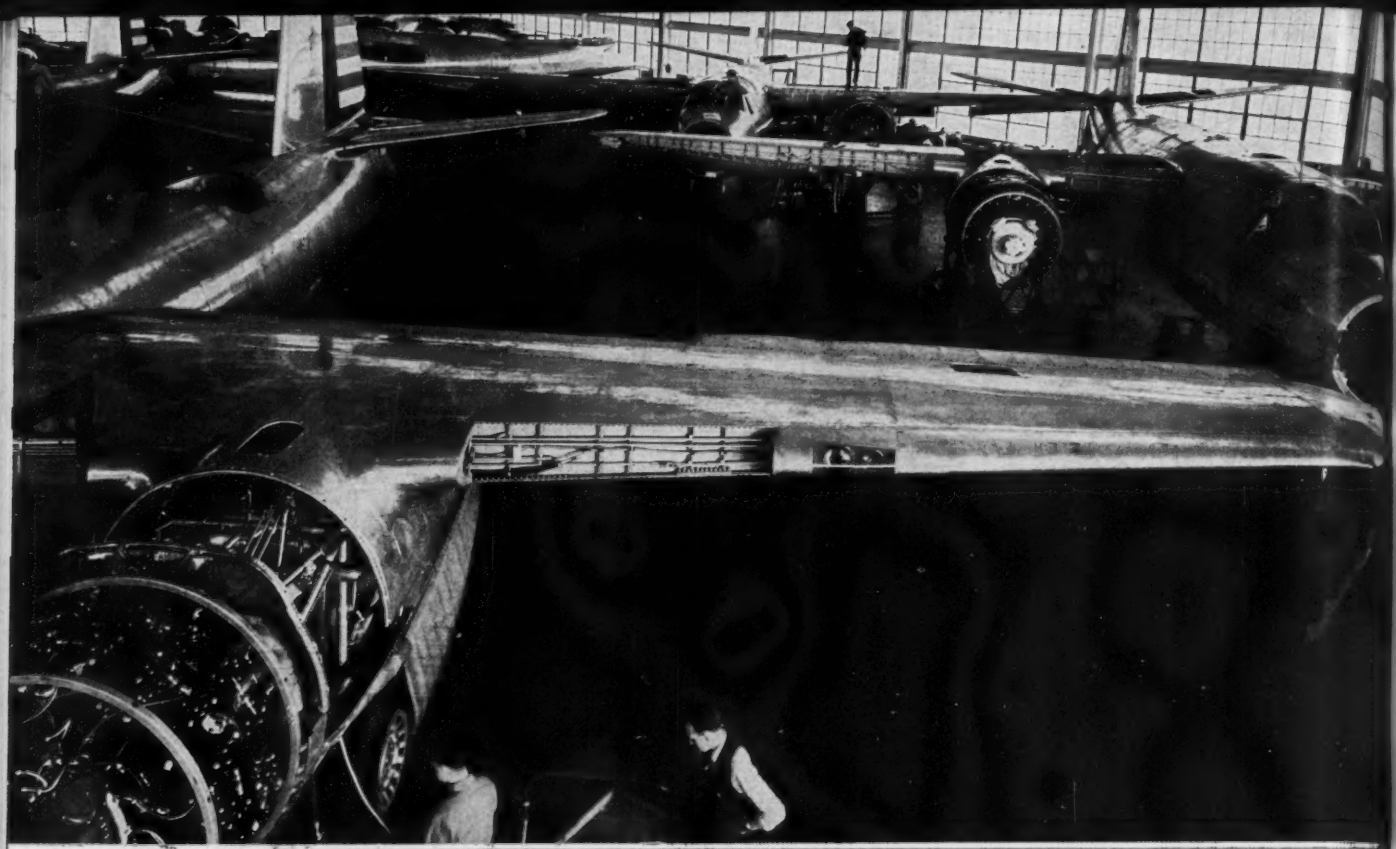
A portfolio describing flexible conduits, connections and fittings manufactured for aircraft use was published recently by the Chicago Metal Hose Corporation. It includes data on shielding conduits and fittings, fuel and oil hose, hydraulic hose fittings, stainless flexible tubing and bellows, aluminum and steel flexible tubing.

Data necessary for design are offered; they include such items as hose, weight per foot, bending radius, test-proof pressure and burst pressure in pounds per square inch.

The portfolio is bound to fit into a standard file, and is indexed and cross indexed with fully visible tabs for quick reference.

Prizes for Welding Papers

The Summerill Tubing Company, Bridgeport, Pa., has established a series of cash prizes to be awarded by the American Welding Society at its annual meeting during October 1941, for papers to advance the art of welding of aircraft steels including tubing and other steel parts for tubular assemblies. The papers may treat of any type of welding which is or can be used for the fabrication of structures or assemblies in the production of aircraft steels, and may cover any phase of the problem. *American Welding Society.*



FORMULA FOR DEFENSE!!

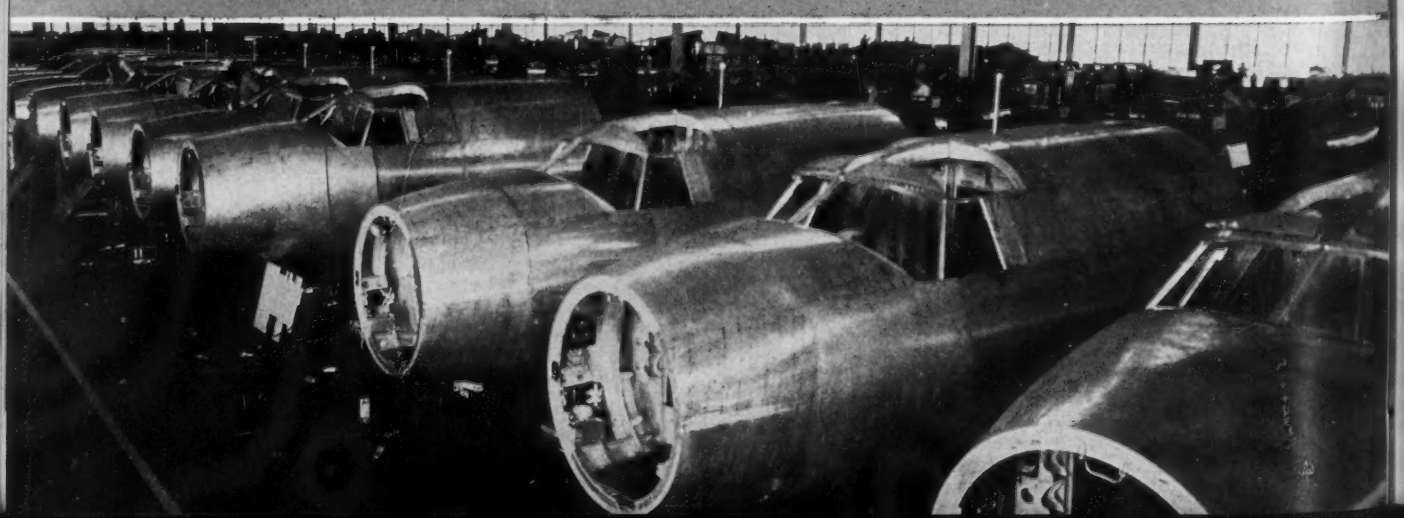
Record-shattering in performance, the Martin B-26 Bomber is shattering production records, too . . . streaming from the most complete production equipment for large military aircraft yet developed in America. So simplified is this production equipment that it widens the expansion bottleneck . . . makes possible the use of thousands of less-trained workers. And the steadily accelerating output of today is only the beginning. The same system is being installed in the new 1,181,000 square foot Army Building at Middle River—from which more B-26's will fly away. Still more will flow from the new 1,225,326 square foot Omaha Assembly Plant, now being rushed to completion. A great stream of airpower is roaring from Martin assembly lines—gathering new force and momentum every day.

Martin
AIRCRAFT

Builders of Dependable *Aircraft Since 1909*

TRADE MARK

THE GLENN L. MARTIN COMPANY, BALTIMORE, MARYLAND, U. S. A.



From the Industry

Civil Aeronautics Administration

Changes in the construction, material and size of airplanes, and in the size of hangars, have gradually changed the whole problem of fighting fires at airports, Fred H. Grieme, Chief of the Airport Section of the Civil Aeronautics Administration, told members of the National Fire Protection Association meeting at Toronto.

All-metal airplanes of huge size can have minor fires within their cabins that will not endanger airplanes in the same hangar, but if these fires are not quickly controlled by firemen using special portable equipment, the large gasoline loads of such airplanes will cause fires of an entirely different character. Open fires in hangars are best combatted by sprinkler systems of the "deluge" type, which pour down thousands of gallons of water a minute. Still different types of equipment are required for paint shop and gas storage fires.

When airplanes were fabric-covered, fires were more frequent, and spread faster, but even the metal airplane of today will burn at gasoline fire temperatures. Hand type portable equipment in addition to the sprinkler system is essential.

Development of mobile equipment for use at airports must keep pace with the problems presented by larger airplanes, Grieme said. Of all aircraft accidents, 69 per cent occur on or within five miles of airports. Today's large airplanes require large and powerful easily moved equipment, which should be equipped with hoists, booms, grappling hooks, tow cables, winches and a circular power-operated saw for getting into fuselages. This equipment should also have flood lights and two-way radio and loud speakers.

A voluntary underwriters' reduction of 20 per cent in the rates for life and accident insurance, public liability and property damage premiums covering the C.A.A. Civilian Pilot Training Program will become effective when the summer session opens on July 1st. This will be the second cut this year and the fifth concession made by the aviation insurance underwriters in the two years the program has been in existence.

Releases are printed as received from companies and other aeronautical organizations and the responsibility for the accuracy of all statements is therefore not assumed by the Aeronautical Review.

The new rate for each student taking private training will be $7.20, including both the $1,000 hospitalization and medical reimbursement and $3,000 accidental death or dismemberment. In the secondary course the cost will be $9.60 for the same coverage.

Each flight operator is required to carry $50,000 to $100,000 public liability, and $5,000 property damage insurance on each C.A.A. student enrolled in his school, and the rates on these policies have also been reduced from $8.00 to $6.40 for private students and from $10.00 to $8.00 for secondary students.

Previous to the establishment of the program, $3,000 insurance coverage cost a student pilot $35.00. The first rate for the C.A.A. controlled course was $20.00. This was cut to $14.00 in the fall of 1939, to $10.00 last June and to $9.00 last September.

British Press Service

One of the most important men in Britain's aviation today is tall, rugged Major Frank Bernard Halford, the designer of the Royal Air Force's newest aero engine, the Napier "Sabre."

This engine, Britain's ace in the hole, which is so unorthodox that Lord Beaverbrook in a recent speech on the achievements of British planes bestowed praise on those who took a gamble on adopting it, is believed to be the most powerful to go into service in any country. It is less than 6 ft. long and develops more power than Britain's crack London to Edinburgh train, the Royal Scot. Owing to its special construction it has a small frontal area and a very reduced "drag." The "Sabre" is the culminating point in Major Halford's career of aero-engine designing; and during his career he has seen many of the blueprints from his drawing board translated into highly successful engines.

Rumors current in aviation circles in North and South America, which are ascribed here to German sources, to the effect that Great Britain has recently been exporting aircraft to South America, have been denied by the British Ministry for Aircraft Production in the following statement:

"There is not one single British plane being exported for commercial purposes. Advertisements which have appeared in South American newspapers are a holdover from peacetime, inserted by commercial agents. They refer to airplanes exported before the war. These agents may also be anxious to keep their goods in the public eye with a view to business when the war is over."

Aeronautical Chamber of Commerce of America

New mastery in the air, with all its military and economic implications, is being won in the research laboratories of American aviation.

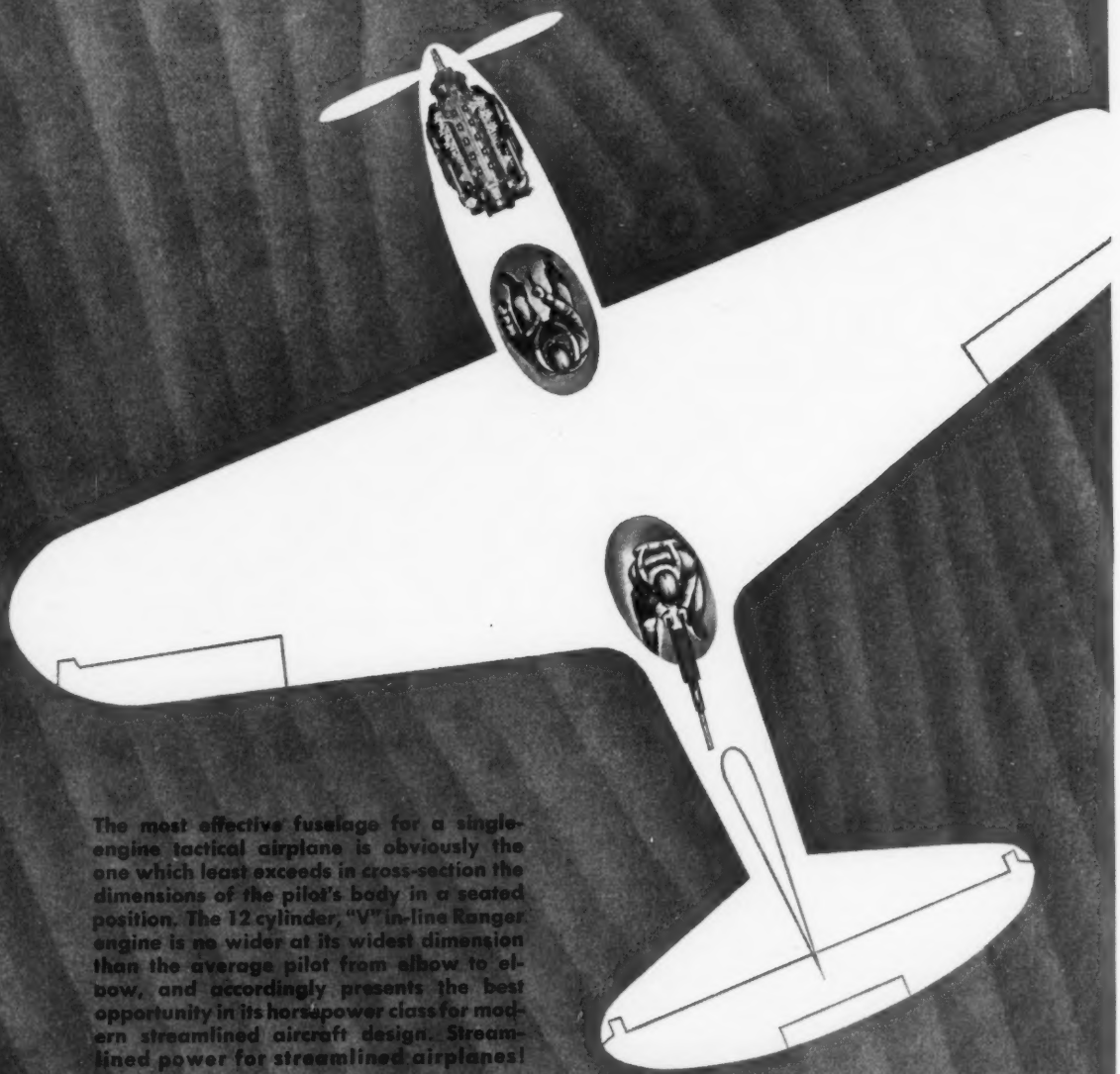
Latest developments on this front include:

1. A new type airplane wing with tremendous potentialities in the realm of increased speed.
2. Continuous improvement in the field of engines and engine supercharging to permit higher performance at greater altitudes.
3. Active research on propeller gear drives designed to widen the range of aircraft.

These statements were made recently by Frank Caldwell, President of the Institute of Aeronautical Sciences and research director for United Aircraft Corp. Mr. Caldwell had just completed an inspection of western aircraft plants.

In spite of emergency demands for increased plant capacity and swift production, Mr. Caldwell found that aeronautical research has been speeded to a point assuring that the United States will not only build the greatest number of airplanes but will also build the best airplanes of any in the world.

HOW WIDE IS A PILOT?



The most effective fuselage for a single-engine tactical airplane is obviously the one which least exceeds in cross-section the dimensions of the pilot's body in a seated position. The 12 cylinder, "V" in-line Ranger engine is no wider at its widest dimension than the average pilot from elbow to elbow, and accordingly presents the best opportunity in its horsepower class for modern streamlined aircraft design. Streamlined power for streamlined airplanes!

WITH RANGER THERE CAN BE NO COMPROMISE WITH QUALITY

RANGER AIRCRAFT ENGINES

Farmingdale, Long Island, New York • Division of Fairchild Engine & Airplane Corporation

In summarizing the fruits of research work and their meaning in terms of warplanes, Mr. Caldwell said greater speed, increased rate of climb, higher service ceiling and longer range are the major military objectives.

Here are some of the research contributions to attainment of these objectives:

Speed.—The laminar flow wing is the newest development in airfoil construction and is exemplified in the North American NA-73, swift American-built pursuit ship. The National Advisory Committee for Aeronautics, closely guards the secrets of the laminar flow development. However, it can be said that it is a wing which increases the area of smooth air flow. This moves back the point where the air "breaks away" from the wing surface. This breakaway decreases "lift" and causes air turbulence which increases "drag" or air resistance.

Jet propulsion, which streams exhaust gases from the engine back along the fuselage and wings, is opening up an important new approach to additional speed.

Power is being increased through engine development. Motors of more than 2,000 hp. are now in use. Experimental work is under way on engines at least 50 per cent more powerful tha nat present.

Climb.—Development of engines in excess of 2,000 hp. is the answer. Propellers must be of as large diameter as possible, to increase the rate of climb.

Ceiling.—Present airplanes of several types have service ceilings in excess of 30,000 ft. and up to 33,000 ft. Researchers are working on a 40,000-ft. level. Two types of engine superchargers are being developed. One uses engine exhaust gases to drive a turbine which in turn drives a centrifugal compressor which compresses air into the engine. The other utilizes gearing from the engine itself to drive the compressor.

Range.—Development of larger aircraft and larger engines is going forward. "The great flying laboratory, the B-19 bomber, is of tremendous value in this field."

A two-speed propeller drive gear is a present subject for active research, he added. This gear shift operates much as the overdrive of an automobile does. In level flight the propeller turns at a high speed, but, due to the gear, the engine turns at a much lower speed, permitting a very low fuel consumption in miles per gallon.

Despite the wide attention focused on the Nazi air force by its dreaded Stukas, the United States today has at least five types of aircraft which can out-perform the much-publicized dive bombers of Hitler's *Luftwaffe*.

Exact figures on speed, range, etc., of individual ships are restricted for military reasons. But, as a method of illustration, the following average performance figures on the American ships have been reported:

Average maximum speed—282 m.p.h.

Average cruising range—more than 1,300 mi.

Average bomb capacity—considerably more than 1,000 lbs.

Contrasted to these averages are a 242-m.p.h. top speed, a 498-mi. range and a bomb load of less than 1,000 lbs. credited by international aeronautical publications to the Junkers Ju 87-B, the stock single-engine dive bomber of the German air force.

As the U.S. Navy pioneered dive bombing, most of the American types are designed for operation off aircraft carriers. They include:

Curtiss SBC2-1, which is said to be 100 miles faster and with a bomb capacity twice as large as any existing dive bomber.

Brewster 340, a heavy dive bomber with exceptional speed and range, two important factors in sea operations.

Douglas SBD-1, large numbers of which are now in service on Navy carriers. In acceptance tests the SBD's established records considerably in excess of performance figures attributed to German and British dive bombers.

Designed for land operations is the Republic Guardsman, a two-seater fighter equipped to carry a 1,350-lb. load as a dive bomber. Still another dive bomber is the Vought-Sikorsky 156, large numbers of which are being built for Great Britain.

American manufacturers also excel in producing torpedo airplanes, the worth of which has been demonstrated by the British in attacks against the Italian Navy in the Mediterranean.

The stock U.S. Navy torpedo plane is the Douglas TBD. Scheduled for production this summer is the powerful Grumman TBF-1. Already in production for overseas is the Northrop N3-PB.

Aero Industries Technical Institute

A departure from the usual training in aeronautical engineering, Aero Industries Technical Institute has inaugurated a six-month elective course in production sciences. This new course of the Los Angeles school includes tool engineering, operations engineering, time and motion study, production planning, production design, cost estimating, standards engineering and plant layout.

This is the second specialized phase of aeronautical engineering added to the established engineering courses of the Aero I.T.I. The first, armament design and engineering, was added a year ago. It is believed that Aero I.T.I. is the only engineering school, either public or private, offering these special courses. The new course was added after long consultation with industry leaders, who uniformly expressed the industry's urgent need for engineers trained in the production sciences being taught.

A number of graduates of the one-year course, who during their year's course received only the first two months of this new training, are already employed in one or the other of the specialized phases of production engineering and have advanced rapidly, so great is the need for men so trained.

The two-months' training received by these employed graduates is an elective part of the one-year engineering course. For the additional four months of special training, the student majors in one of the eight subjects offered.

Atlantic Instrument & Tool Co.

The Atlantic Instrument & Tool Company of New York City has just been organized for the manufacture of precision measuring instruments, adjustable snap gauges and other tools. The snap gauges are being made to American Gauge Design Standards and are now in production.

In addition, the company maintains a department for special work that can be produced on fine precision lathes, and is already making parts for a nationally known plant engaged in the manufacture of instruments for the defense program. The equipment of the Atlantic Instrument & Tool Company includes the most modern inspection and measuring devices to guarantee the production of work to very close tolerances.

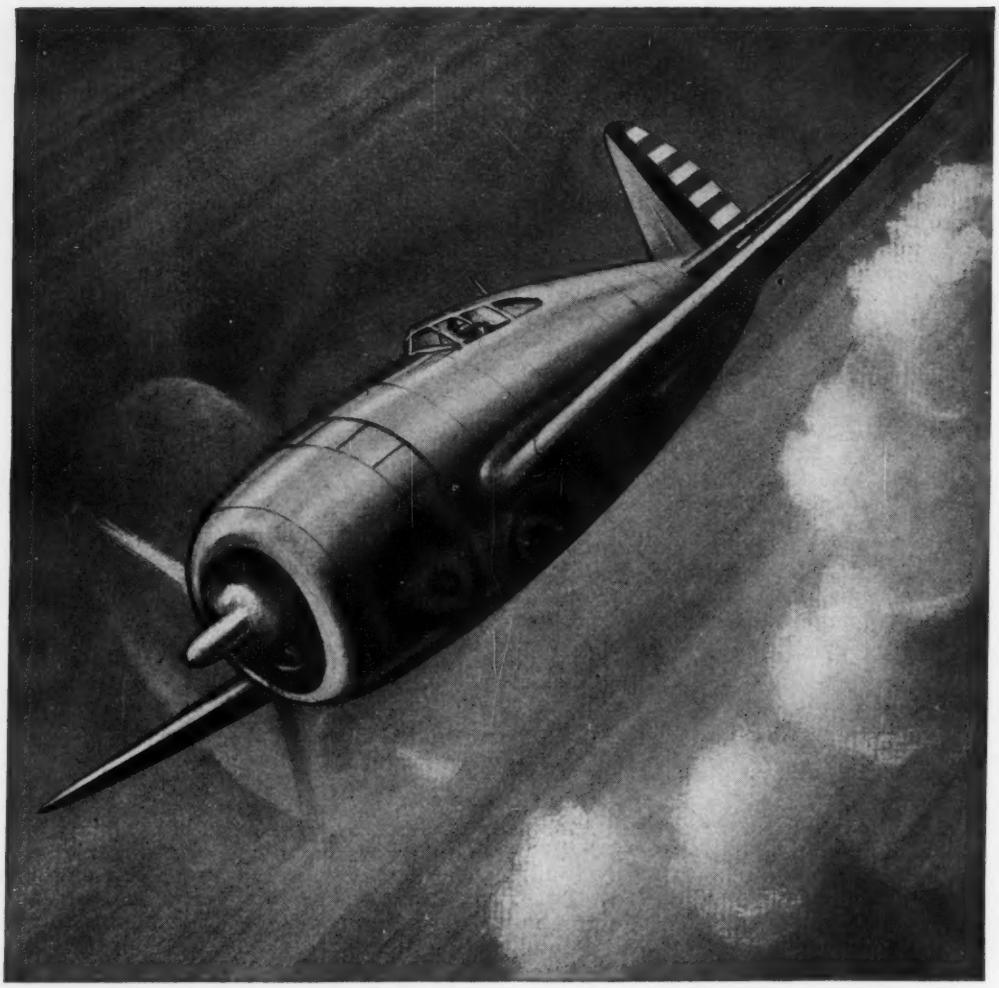
Edward G. Budd Manufacturing Co.

Application of induction heat treatment to the bores of cast iron cylinder liners used in its entire line of Diesel tractors has been announced by Caterpillar Tractor.

This is the first 100 per cent production application of electromagnetic heating to the cylinder bores of internal combustion engines, and is an adaptation of the revolutionary process developed by Budd Induction Heating, Inc., a subsidiary of the Budd Wheel Company of Detroit.

The treatment produces an I.D. surface of controlled hardness, depth from the surface and area in the bore of the liner, resulting in a longer-wearing sleeve with markedly improved physical properties, it is claimed.

In this installation, to which Caterpillar has applied the trade name "Hi-



REPUBLIC AVIATION

SALUTE TO THE "THUNDERBOLT"—Republic Aviation Corporation proudly announces the completion of its P-47 interceptor—the Republic "Thunderbolt," the first Army pursuit airplane to utilize an engine of 2000 horsepower. In the "Thunderbolt," the United States Army Air Corps now has one of the most powerful and most advanced fighting planes known to have flown. Designed and produced in record-breaking time, the "Thunderbolt" meets every modern requirement in its fire power and protective equipment. Manufactured in quantity, the "Thunderbolt" assures definite aerial supremacy for the defenders of our Country.

REPUBLIC AVIATION

REPUBLIC AVIATION CORPORATION
FARMINGDALE, LONG ISLAND, NEW YORK, U.S.A.

Electro," the heat treating machine hardens the inside diameters of the cast iron liners to a surface hardness of Rockwell "C" 52–55, which is subsequently tempered to a slightly lower hardness. Depth of the hardened area developed is approximately .070 in. Liners from 10 to 15 in. in length, with bores varying from 3¾ to 5¾ in. I.D., for the different sizes of Diesel engines manufactured by Caterpillar, are in production. Following the operation of hardening and tempering, the bores are honed to the final finish, before "Surfiding" after which the O.D. is finish-turned for insertion into the cylinder blocks.

The finished sleeve is reported to be superior in physicals and wear-resistance to any which have been previously produced. While the bores are extremely hard, providing maximum resistance to wear, the sleeves are not brittle. Quality and uniformity of product are maintained at the highest standards.

An interesting feature of this method of heat treatment is the fact that the hardening operation serves as an additional check on previous inspections of the units treated, as the treatment serves to emphasize any porosity or imperfections which may have escaped visual and surface examinations.

Differential hardening by electromagnetic induction is accomplished through the concentration of high power, high frequency currents in the surface zone to be hardened. As applied in the Budd method of hardening the inside diameters of cylindrical objects, such as cylinder liners, the currents are caused to flow almost entirely in the shallow internal surface zone to be heated and to be so concentrated that the temperature of the zone affected is raised to hardening temperature before any substantial amount of heat can drift to the remainder of the piece.

In this way, the required heat is almost instantaneously generated in the zone to be hardened. This thermal energy is then "trapped" through the immediate application of a controlled water quench. An extremely hard surface is thus obtained, while the remainder of the cylinder, due to the speed of the operation, has remained relatively cool and has therefore not been affected from the viewpoint of hardening.

As the power input and timing of the current application, and the volume, pressure and angle of direction of the quench are accurately controlled, the hardness developed, depth of the hardened area and the area treated are also controlled within exceedingly close limits. The time required for the entire heating and quenching operation is a matter of but a few seconds.

The first successful application of the process was to the bore of automobile hubs, in which a section of the I.D. was hardened to form a roller bearing race. More than 4,000,000 of these units have been turned out for a major automotive manufacturer without a failure being reported, according to Budd engineers.

Development of the Budd Induction Method of heat treating inside diameters was undertaken with a specific aim in mind. It had long been recognized that if the bore of a cylindrical object could be hardened, while the remainder of the part was held in an undisturbed and machinable condition, the entire manufacturing operation would be simplified. Existing methods of hardening did not meet design and production requirements.

The aim was to develop a hard, wear-resisting bore on the inside diameter of a cylinder, while leaving the remainder of the unit undisturbed. This having been achieved, improved physicals would naturally result; for example, greater resistance to bursting or collapse would follow if this metallurgical condition could be attained.

It was also hoped that a wider range of materials, including non-alloyed ferrous metals as well as the alloyed, could be satisfactorily treated, thus making possible less costly and more satisfactory designs.

All of these advantages have been realized. Further, a control system which operates automatically assures uniformity of hardness throughout the treated area, uniformity of area treated and uniform depth of areas hardened, thus assuring steady production of units of controlled metallurgical properties.

Composite heat treatment is also possible. A tube which has been heat-treated throughout may, as one engineer has expressed it, be "kissed" on its I.D. by the Budd heat treating head to produce a harder interior surface, thus improving wear-resistance of the bore, while retaining high physicals.

High speed of production is another advantage. In the automobile hub application, for example, Budd is hardening the I.D. of three to four hubs per minute with each machine in operation. Aviation cylinders, it is claimed, can be treated at the rate of 60 to 100 per hour per machine.

A. M. Byers Company

The A. M. Byers Company will enter the field of alloy steel manufacture about June 15th, when its new electric furnace equipment will be placed in initial operation.

Available alloy steel production for defense needs will be increased by another 30,000 to 40,000 tons a year, according to L. F. Rains, president.

Construction of a plant addition and the installation of electric furnace equipment at the Byers Ambridge works have been speeded because of the shortage of alloy steel in the present emergency, he stated, and added that production will begin six weeks ahead of the original schedule.

Initial products will be billets and bars for alloy steel fabricators.

Douglas Aircraft Company

To speed national defense production by facilitating greater standardization, Douglas Aircraft Company has released to America's airplane industry all rights to its specially developed and patented method of flush riveting with 100° rivets.

This was announced today by the National Aircraft Standards Committee, which disclosed that at its last meeting Douglas representatives formally gave the aircraft industry, in the interests of national defense, all legal authority to use and derive the production advantages of the Douglas Company's patent No. 2,233,820.

This patent covers the method of flush-riveting sheetmetal airplane parts with rivets having any usual angularity of head, preferably an angle approximating 100°. By such a process considerable flush riveting can be done without the otherwise necessary "predimpling" of parts.

Recently granted its patent on the process, which now is in use by most leading airplane manufacturers, the Douglas Company by its release has made the method available to the entire industry without cost or liability.

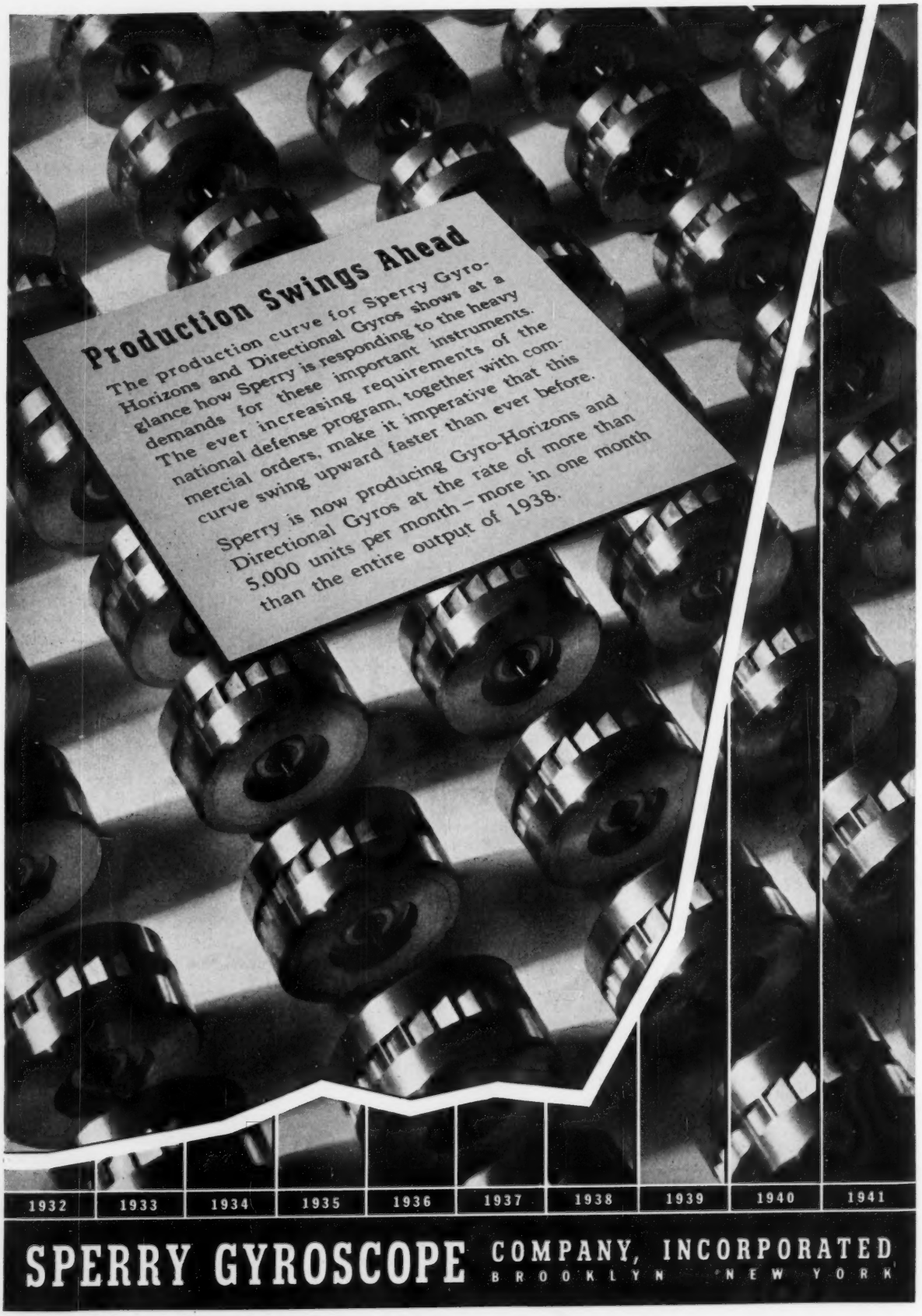
According to the Standards Committee's announcement, Douglas today is using flush riveting with 100° rivets on all exterior surfaces of its powerful attack ships and bombers, decreasing wind resistance and resulting in airplanes which are swifter and aerodynamically more efficient.

Eastman Kodak Company

Development of Matte Transfer Film, a photographic material for sensitizing metal plates for use in a template process that shortens the time between engineering and test flights in the aircraft industry from two to four months, is announced by the Eastman Kodak Company.

According to an official of the Lockheed Aircraft Corporation, with the development of this new film for use in their new photo-loft-template process, aircraft production cost is cut approximately $20,000 a model.

With the use of Matte Transfer Film, engineering drawings can be printed either by contact or by projection on these photosensitive metal sheets and


Production Swings Ahead
The production curve for Sperry Gyro-Horizons and Directional Gyros shows at a glance how Sperry is responding to the heavy demands for these important instruments. The ever increasing requirements of the national defense program, together with commercial orders, make it imperative that this curve swing upward faster than ever before.
Sperry is now producing Gyro-Horizons and Directional Gyros at the rate of more than 5,000 units per month – more in one month than the entire output of 1938.
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SPERRY GYROSCOPE COMPANY, INCORPORATED
BROOKLYN NEW YORK

the processed plates bearing the photographic image are then sent directly to the Template Department to be cut out and used as a template. The templates are made by cutting around the photographic outline by means of a saw or mechanical shears.

In the contact method of making prints on photosensitized metal, the engineering drawings are made on metal plates which have been given a coating of a material which will fluoresce in the presence of X-rays. This coating is likewise of such a nature that it can be drawn upon satisfactorily. If positive prints on the metal are desired, a photosensitive glass plate is placed in contact with a treated surface of the plate bearing the mechanical drawing and the exposure is made by means of X-ray through the back of the metal plate. The processed glass negative is then printed onto a sheet of photosensitized metal in the usual way. If a mirror image negative on metal is used for the templates, the photosensitized metal sheet is placed in contact with the above treated metal drawing sheet and exposed through the back of the metal by means of X-ray. The negative mirror images obtained may, of course, be made into "right" images by simply turning over the finished template.

The Lockheed Aircraft Corporation, a pioneer user of Eastman Matte Transfer Film, has made satisfactory use of enlargements of mechanical drawings on photosensitized metal plates. In this process the mechanical drawings are made directly upon lacquered metal sheets. These mechanical drawings are then photographed on glass plates in a special camera designed for this purpose. These glass negatives are then enlarged onto the photosensitized metal sheets. By this method phototemplates as large as 4 × 12 ft. have been made.

If great care is taken in the selection of the cameras and lenses used for this purpose, it is reported that photo-templates can be made with a tolerance of 0.001 in. per ft.

It has been found that the most simple and effective method of producing sheets of photosensitized metal consists of laminating Matte Transfer Film to lacquered metal sheets. The film consists of a sensitive emulsion coated on a thin film support, the latter backed by a paper base. When used, the sensitized strip is transferred from the supporting paper base to the lacquered metal plate. This film has a matte surface, so that it will take a pencil line in case changes or additional developments on the processed photographic image are desired.

At the present time the width of Matte Transfer Film is limited to a maximum of 34½ in. If wider plates are desired, several strips of film are used to give the desired width and the plate is passed through the machine the required number of times for proper lamination of the film.

To further aid manufacturers who are interested in the use of Eastman Matte Transfer Film, experts of the Kodak Company are available to anyone interested in designing and installing the equipment necessary to produce phototemplates.

Elastic Stop Nut Corporation

For use on shear bolts where a high degree of the stress is lateral, and for general application to light and medium stress fastenings, an improved line of thin hex nuts is announced by Elastic Stop Nut Corporation.

These nuts have approximately 40 per cent of the strength of standard height hex nuts and have been developed to meet the demand in virtually every industry for a self-locking fastening which offers savings in space requirements, weight and cost. An indication of their suitability is the fact that they are approved for use on aircraft by all of the military and civil authorities.

As in the standard-height Elastic Stop Nuts, the self-locking action is accomplished by means of a vulcanized fiber collar which is built into the head of the nut. This tough bone-like material resists the entry of the bolt, thus forcing the nut outward and taking up all thread play. The fiber, being non-metallic and of a resilient character, does not deteriorate under vibration, and so continues to hold the threads of nut and bolt in a constant pressure contact.

The nuts are available in steel, brass and aluminum, in a complete range of standard sizes, both coarse and fine thread.

Gaertner Scientific Corporation

Using standard optical bench parts, such as are frequently employed in research laboratories, it is a simple matter to build a projection comparator for the examination of small parts. A projector assembled in this manner has three major advantages: (1) The cost is comparatively low. (2) Parts are interchangeable so that other equipment may be added as desired (usually no machining operations are necessary). (3) The individual parts, such as the microscope, the high power lamp and the swiveling clamp can be put to many other important uses in the shop.

The projector comprises a high powered lamp, operating on a 6-volt transformer, which illuminates the horizontally-mounted microscope. At the extreme right is the ground glass screen on which the image appears. Each of these parts is mounted on a detachable rod of standard diameter, which is a good sliding fit in a right angle clamp. The clamps, in turn, are mounted on a long rod of square section, along which they can be moved for adjustment. The square horizontal rod is provided with detachable end supports.

Between light source and microscope is mounted a standard swivel clamp in which is detachably inserted a rod having its upper end threaded. To this can be attached a small platform with centers, V-block or other method of holding the object to be examined. The swivel clamp is so constructed that the upper portion rotates accurately on the lower portion, a scale on the clamp reading the rotation directly to 5°; 1° can be estimated readily. The upper portion of the swivel clamp has a cross-slide operated by a screw, having a range of motion of 1 in.

In operation, the part to be examined is placed in an object holder improvised by the user on top of the vertical rod in the swivel clamp, and the swivel clamp moved back and forth in front of the microscope until a clear image of the object is focused on the ground glass screen. Final focusing can be accomplished by the rack and pinion on the microscope. The actual enlargement can be determined readily by measuring on the screen the distance between two points on the object, the actual distance between which is known. For measurement on screw threads, the swivel clamp should be rotated to correspond with the helix angle of the thread.

The image is clearly visible in a well-lighted room, but for best results, direct light should be shielded from the screen. An additional improvement will be effected if a small disk, about 4 in. in diameter of cardboard or metal, is attached to the microscope to shield the screen from stray light from the projection lamp.

In place of the ground glass screen, the user can substitute drawings on translucent paper with which the object can be compared. No re-focusing is necessary when it has once been adjusted to a given object. A standard microscope will give magnifications up to about 50 times. It is possible to obtain magnifications of 100 times and more by interchanging microscope objectives, which are low in price.

Lear Avia, Inc.

Advance orders on the new Learavian three-band portable receiver exceed 1,000 units, William P. Lear, president of Lear Avia announced from the new Lear plant at Piqua, Ohio.

On the ground, the Learavian may be operated from its own, self-contained

WESTON

Aircraft Instruments

Back in those days when flight instrumentation was still in the development stage, *even then* there were instruments in use which were recognized as thoroughly accurate and dependable. These were the power supply instruments furnished by WESTON. For the *exact* science of electrical measurement had been founded by WESTON over a quarter of a century before.

Today, as giant bombers and transport planes roll off production lines, these same power supply instruments, together with many other electrical types developed by WESTON, are found on the instrument panels. For the aviation industry continues to demand that extra increment of dependability still available in electrical measurement... by WESTON. Weston Electrical Instrument Corporation, 625 Frelinghuysen Avenue, Newark, New Jersey.

dry cells or from AC or DC household line; when used on board aircraft, the electric cord is neatly folded into a small compartment in the back of the case, and the unit operated from its own dry cells.

The Learavian provides complete coverage of aeronautical and broadcast frequencies in three bands: 195–410 kcs. (airways and marine radio ranges, weather broadcasts and traffic control), 540–1,560 kcs. (standard broadcasts) and 2,200–6,300 kcs. (airways communications, including private flying, air lines, coast guard and Army and Navy aeronautical frequencies).

In addition to its built-in loop antenna for use on the ground, the Learavian also provides a special plug-in connection for use with an external antenna on board aircraft, as well as a ground connection. When not in use, the demountable plug with its antenna and ground connection wires is carried in the compartment in back of the case.

Similarly, in addition to its built-in loudspeaker, a headphone jack is also provided. When the headphones are plugged in, the loudspeaker is automatically cut out of operation.

An added feature of the Learavian portable, heretofore available only in the more expensive aviation receivers, is the built-in interphone system, invaluable for instruction and for intercommunication between cockpits. Simply plug a microphone into a jack provided in the panel; the only operating control is the microphone "press-to-talk" button.

The Learavian control panel is located in the top of the case and mounts master on-off and volume control, threeway band switch, tuning control and slide-rule type dial, power selector switch, external antenna and ground connection jack and microphone and headphone jacks.

Housed in an attractive carrying case, the Learavian measures $8\frac{1}{2}$ in. high, 12 in. wide, 6 in. deep and weighs only 14 lbs. 3 oz., including self-contained dry cells sufficient for 200 hours of operation.

Luscombe Airplane Corporation

A new version of the Luscombe Silvaire is now being shown by dealers. Replacing the former Luscombe "Standard" it is powered by a dual ignition 65-hp. Continental engine. The introduction of the new model marks the completion of the 1,000th all-metal Luscombe airplane in the low-price field, the first of which, now privately owned, is still in active use at West Trenton, New Jersey. Designated as the Silvaire "Master," the new airplane has a full monocoque fuselage of Alclad skin riveted to Dural bulkheads, all-metal wing structure and metal control surfaces. Instruments are shock mounted. Large glove compartments on each side of the panel provide ample space to accommodate any of the popular lightplane receivers and transmitters.

Twin mufflers are standard equipment. These were developed by Luscombe engineers and have undergone exhaustive tests, the results of which have shown that no back pressure, loss of revolutions or overheating exists in their use. A simple mechanical starter is also provided in the new ship. The crank operates through a small hole in the center of the instrument panel and provides a straight-line connection to the starter which greatly simplifies operation. A firewall well is built into the craft to accommodate the starter unit. Another major improvement is the new balanced airliner type trim tab which operates on a worm gear unit mounted between the seat cushions. This new tab gives finger-tip control and eliminates the former bungee arrangement.

Compensated compass, brakes, parking brake, heavy-duty tailwheel, ash receiver, cabin heater, ventilators and many other important refinements are standard with the new model.

Wing span is 35 ft., weight empty is 665 lbs. and useful load is 535 lbs. Design level flight speed is 115 m.p.h. and landing speed is only 37 m.p.h. The 15-gal. fuel tank in back of the cabin gives a range of 350 mi.

National Aeronautic Association

Rapidly deepening its reservoir of trained pilots, the Army Air Corps is about to train thousands of new recruits in enlisted grades for flight duty. Legislation for this purpose has been approved by the Military Affairs Committees of Senate and House for early enactment.

Since the World War, the Air Corps pilots have all been commissioned officers. Reinstatement of the policy of drawing pilots from enlisted personnel as well has long been advocated by N.A.A.

According to recent official testimony, the Air Corps plans nearly to double its personnel with the addition of more than 150,000 men. It has not yet been announced how many will be trained as pilots and how many for other technical and non-technical duties, such as bombers, gunners, observers and mechanics.

Meanwhile, the training of air cadets, to become commissioned officers on completion of their courses, is expanding from the previous rate of 12,000 per year to the new goal of 30,000. This schedule calls for the induction of 5,000 every five weeks.

It is expected that the number of civilian schools aiding the military program, now about 30, will have to be doubled. The C.A.A. Civilian Pilot Training Program, slated for $25,000,000 to continue through the next fiscal year, is undergoing further refinements toward maximum usefulness to national defense.

Funds for C.P.T.P. are still before the Senate Appropriations Committee with hearings about to start on the House-approved State-Justice-Commerce supply bill in which pilot training was boosted above the budget.

Emergency need for aircraft workers is directing the attention both of the industry and of official agencies to the employment of women on many types of jobs which they can well perform, as demonstrated in the munitions industry and other defense production programs.

In all the aircraft centers of Europe, women are employed in semi-skilled capacities for almost every phase of airplane production except the most highly skilled work requiring years of machine shop experience which few women possess. In the United States, some of the small plants, which use older methods, have women workers. As yet, few women are on the assembly lines of the big plants.

The pressure of fast growing production plans, however, is thought likely to bring drastic changes in personnel policies over the next few months.

Although the present scarcity of aluminum is bound to mean a sharp curtailment in the supply of the metal for civilian aircraft production, as in all activities in the non-military or "B classes," O.P.M. officials are giving every possible consideration to the phases of civilian flying which are indispensable for public service and as defense auxiliaries.

Aircraft and parts for civilian uses, according to a recent statement by E. R. Stettinius, Jr., Director of Priorities, have been given a B-8 rating under which only 10 per cent of the average orders of high grade aluminum during 1940 for these uses will be released. Exceptions will be granted, however, "as higher ratings or allocations may be provided in special situations."

Little publicized but highly significant in view of European experience is the development by the Army Air Corps of its own air cargo system. Regular interdepot freighting schedules have been established in the United States and to Panama, later to be extended to outlying defense areas such as Alaska, when equipment is available.

Some 40 large transport planes are being used in this service. Beyond

ALUMINUM, DEFENSE, AND YOU

ALCOA

3

IT IS EASY TO UNDERSTAND ABOUT ALUMINUM AND DEFENSE

THE WHOLE THING BOILS DOWN to two simple questions:

1. **How much aluminum** are America and England going to need? There is only one answer: The democracies must have *all the aluminum it takes to win*, and nobody knows how much that is.
2. **How fast** is aluminum needed? We don't know, for sure, but just as fast as the aircraft plants, munition plants, shipyards, and the like, can be expanded to use aluminum and other materials for defense purposes.

THOSE IN AUTHORITY IN WASHINGTON are putting together, day by day, expert estimates of what all these defense industries are going to need, month by month, clear to the end of 1942. These estimates, as issued, are our book of rules.

FOR MONTHS WE HAVE BEEN, and are now, delivering aluminum for defense purposes far in excess of that called for by prior estimates.

DEFENSE IS NOW TAKING from us over 40 million pounds a month. Every American ought to have a picture of just how much aluminum that is; here it is:

Peace-time America, during the nine years from 1930-8, could find use for only 14 million pounds a month from us.

In the busy year of 1939 we had to make only 27 million pounds a month to satisfy the civilian needs of this prospering country.

Suddenly, defense alone needs 40 million a month! 14 million (civilian), to 27 (civilian), to 40 (defense) and soon to 50 and beyond!

★ ★ ★ ★

YOU CIVILIAN USERS of aluminum are grand people.

THE WAY YOU ARE DOING WITHOUT aluminum until producers can catch up again with civilian uses is typically American. We are sincerely grateful for your understanding.

IN THIS RECESS you are having to scramble for **RECESSITIES**—other materials which just don't fill the bill 100%, because there is no pat substitute for aluminum.

IT'S TOUGH ON YOU and it's hard on us to have to turn away temporarily from the friends and pursuits of a lifetime.

WE HAVE NOT TURNED OUR BACKS!

WE INTEND that no civilian shall have to forego the things aluminum can do best one minute longer than we can help.

ALUMINUM COMPANY OF AMERICA

this, according to Congressional hearings, the Army will acquire 275 new, modified carrier planes of the same capacious type now flown by the air lines. That increase will give the Air Corps about 525 cargo planes. In emergency, additional planes could be supplied from the fleet of some 350 now in air line use.

Pyrene Manufacturing Company

The national emergency has finally produced an extinguishing agent that puts out magnesium fires in industry and in incendiary bombs. This new substance, known as Pyrene G-1 Fire Extinguishing Powder, is the result of combined research by the Dow Chemical Company, Midland, Mich., manufacturer of magnesium alloys and the Pyrene Manufacturing Company, Newark, N. J., fire protection engineers and extinguisher manufacturers.

In addition to incendiary bombs, the use of magnesium alloys has skyrocketed in aircraft and other defense production. Protection against metallic fires, therefore, is a national necessity. Usual extinguishing methods, however, do not work. Makeshift substances such as tale, soapstone and sand are unsatisfactory. Water or any substance containing moisture increases the speed of combustion, sometimes with explosive violence.

The new product, Pyrene G-1 Fire Extinguishing Powder, is a dry inert compound that stops the combustion of magnesium as well as other metals such as sodium, potassium, aluminum and zinc. It also contains a material which, when heated, forms a heavy, air-excluding, fire-smothering vapor. The powder is applied to the fire by spreading it with a scoop or shovel. Being non-abrasive, it may be used freely around machinery.

The National Fire Protection Association Quarterly for April 1941 points out that "the usual extinguishing agents have no extinguishing effect on burning magnesium alloys, and the best extinguisher for this type of fire is a special powder developed by the Dow Chemical Company in cooperation with the Pyrene Manufacturing Company, to be marketed by the latter."

It is emphasized, however, that proper types of approved fire extinguishers are needed to put out secondary blazes in nearby combustible materials ignited by the metallic fire.

Republic Aviation Corporation

The Republic XP-47B "Thunderbolt," first 2,000-hp. single-engined fighter plane to be produced for the United States Army, is being tested by the Materiel Division of the Air Corps, according to a War Department announcement.

Engineered and constructed in record-breaking time, the "Thunderbolt" is the forerunner of a large number of similar planes to be manufactured by Republic Aviation.

The first airplane has been test flown and is now based at an Air Corps field, where further studies are being made to evaluate the possibilities of its revolutionary design and power installation.

The "Thunderbolt" was designed by Alexander Kartvoli, chief engineer of the Company, who is responsible for its other military aircraft, including the "Guardsman" dive bomber and the P-45 "Lancer" pursuit, which is now in full-scale quantity production for the Air Corps. Company officials believe his design for the new fighter has solved the problems of pioneering in new ranges of engine horsepower and military efficiency, while insuring all possible design advantages for mass production.

The full text of the War Department announcement on the Republic P-47 "Thunderbolt" follows:

"The War Department announced today that a new pursuit airplane, the XP-47B, manufactured by the Republic Aviation Corporation of Farmingdale, N. Y., is undergoing test for the Army Air Corps. The new single-place interceptor, which has a four-bladed propeller, is powered by a Pratt and Whitney radial fourteen-cylinder engine, developing 2,000 hp. Of all-metal construction, the airplane is comparable in weight with the Lockheed P-38 but is slightly smaller in over-all dimensions. For combat conditions, the new airplane will be heavily armored and have strong fire power from large and small calibre guns. Interceptor planes are fast climbers, their mission being to attack bombers and fighters."

Square D Corporation

A special non-magnetic building for magnetic compass assembly and adjustment is one of the unusual features of the plant addition recently completed for the Kollsman Instrument Division in Elmhurst, New York.

The new addition, together with the other supplementary plant divisions being put into operation in Long Island City and Woodside, will mean an increase of almost 100 per cent in available plant capacity within the last six months.

This expansion has been made necessary by the demands of the defense program for large numbers of sensitive altimeters, air speed indicators and numerous other precision aircraft instruments manufactured by Kollsman.

The construction of the new building which adjoins the main factory in Elmhurst was substantially completed in 60 working days from the date construction was begun.

In order to obtain the non-magnetic construction in the special compass assembly building, many unusual construction features were included. Nonferrous metals such as copper, brass and aluminum were substituted for the regular steel and iron in piping, conduits, nails, bolts, etc. Special permission was received from the building department for the use of terra cotta pipe in place of the usual cast iron type.

For the outside of the building, brick was used in place of the regular reinforced concrete which would have created magnetic interference. Wooden beams and joints with copper shoes were substituted for the usual structural steel construction.

Even special work benches and stools entirely of wood with brass bolts have been made for this building in place of the metal ones used throughout the remainder of the factory.

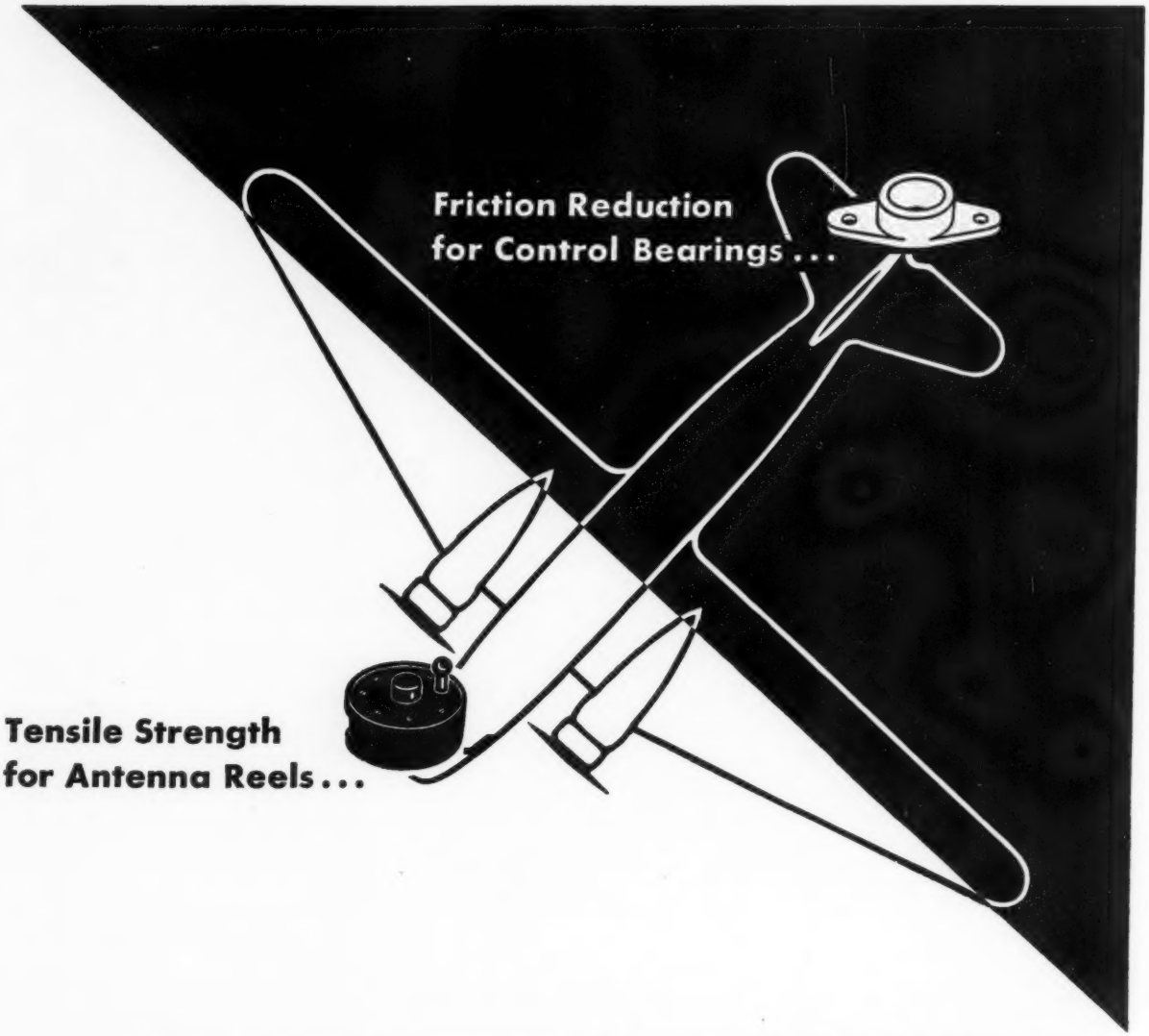
Compass parts for assembly will be transferred from the main buildings to the compass assembly building in a dumbwaiter made especially of wood and bronze.

As the result of this non-magnetic construction, compasses can be assembled and adjusted which will be perfectly balanced magnetically. When properly compensated upon installation in the plane for the local magnetic interferences, they will be much more accurate than compasses now in use.

Stephens-Adamson Manufacturing Co.

A recent development in the materials handling field is the pneumatic roller, for carriers on belt conveyors, wherever the shocks of impact are excessive. It is introduced by the Stephens-Adamson Manufacturing Co., makers of the well-known line of S-A Belt Conveyors and Bucket Elevators. These pneumatic carriers are specially designed for use under loading spouts and in belt feeders where the impact of heavy bulk loads subject both conveyor belt and carrier to abnormal strains and wear. To cushion the impact of materials, thereby prolonging conveyor belt life, the rollers in these carriers are made up of a series of pneumatic rubber units, 6 in. in diameter, suggestive of miniature automobile tires. Their advantage over a solid roller has been compared to the advantage of the pneumatic tire for trucks and automobiles over the now obsolete solid rubber tire; greater resiliency to shock and impact and increased life.

The rollers in Stephens-Adamson Impact Carriers are mounted on the steel hub in which bearings and shaft



. . . both properties are provided by BAKELITE Plastics

BAKELITE Plastics, in their many varied forms, are being called upon to meet an increasing number of exacting aircraft service requirements. Two extreme uses emphasizing the diversity of plastics applications in aircraft construction are *molded* control bearings and *laminated* antenna reels.

Consolidated Aircraft Corporation required surface control bearings with a low coefficient of friction. This problem was solved by molding the bearings from a graphite-filled BAKELITE *Phenolic* Plastic. Additional advantages obtained were corrosion resistance and weight reduction.

Lear Avia, Inc., on the other hand, sought a lightweight material with superior tensile strength, for the housings of its trailing antenna reels. After careful testing, sturdy laminated plastics were specified. Although considerably lighter than metal, the plastic housings withstand severe vibrations and the drag of the weighted antenna. Furthermore, they possess the necessary high dielectric strength.

We invite you to present your plastics problems to BAKELITE PLASTICS HEADQUARTERS. Here you may obtain information on hundreds of different plastic materials that meet almost every service need. Also, write for Booklet 46P, which describes these materials.

BAKELITE CORPORATION, 30 EAST 42ND ST., NEW YORK
Unit of Union Carbide and Carbon Corporation

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PLASTICS HEADQUARTERS

are housed. Roller units have thick, wear-resisting treads and are inflated and permanently sealed to prevent loss of air. The assembly is built for easy servicing and quick replacement of damaged units. The carriers are identified as "Style No. 711 Pneumatic Impact Carriers."

United Aircraft Corporation

Expanding its experimental and research facilities, the Hamilton Standard Propellers Division of United Aircraft Corporation recently completed a new one-story building which contains a fully-equipped propeller laboratory, as well as additional engineering office space. Erection of the structure further ensures for Hamilton Standard the distinction of having the most complete propeller research facilities in the United States, if not in the entire world.

The new building adjoins the experimental propeller test houses built last year and covers an area of 6,000 sq.ft. It includes a "cold room" for testing the operation of propellers at low temperatures; a "whirl rig" by means of which the effects of excess rotational speeds, of erosion and high temperatures may be studied; a balancing room, where dynamic and aerodynamic balance of propellers is determined; miscellaneous special equipment for testing propeller accessories; and office space for a number of experimental test engineers.

The cold room was formerly in a small building off by itself and has been moved to the new laboratory so as to be more convenient to other research facilities. In its new location the cold room is 20 per cent larger than previously. The cold weather operation of propellers and accessories may be tested here to temperatures as low as 50° below zero.

The so-called whirl rig is a special arrangement designed by Hamilton Standard engineers to reproduce three different conditions encountered in propeller operations. One of the conditions is that which occurs when various materials—such as sand, gravel, cinders or water—impinge upon propeller blades and produce erosion. Another condition is that experienced when propeller blade cuffs and fairings are subjected to high temperatures such as those found in tropical climates. The third condition consists of the rotation of propellers at above-normal speeds. The whirl rig saves time in studying these conditions, since effects experienced during ground and flight operations over a period of months may be reproduced here in a few hours.

The whirl rig consists of an enclosed, sound-proofed chamber in which a test propeller may be rotated at high speeds, while erosive material is projected at the blades and a radiator heats the chamber.

Mounted on the end of a shaft driven by a 185-hp. engine in an adjoining room, a test propeller may be rotated at speeds up to 4,000 r.p.m.

In the forward part of the chamber is a small inlet through which erosive material may be projected at the whirling propeller blades. An automatic stoker feeds the material to the inlet and compressed air shoots it at the propeller. Another, larger opening in the forward part of the chamber connects with a horizontal air intake stack. A blower in the stack makes it possible to supply air to the chamber at rates up to 7,000 cu.ft. per minute. The air exhaust stack is located in the ceiling of the chamber.

At the rear of the whirl rig chamber is a radiator heated by the exhaust gases of the engine that drives the propeller shaft. The radiator can heat the air in the chamber to as high as 150°.

From a control desk in the adjoining room a test engineer may vary the conditions in the chamber, noting operations from the array of instruments on the panel before him or through the soundproofed window that looks into the chamber.

With the cold room and the whirl rig, Hamilton Standard's new laboratory provides means of studying propeller operations over a temperature range of 200°—all the way from the 50° below zero that is found at high altitudes, to 150° above.

The remaining space in the propeller laboratory is occupied by a battery of test benches on which accessories such as propeller governors and feathering pumps are subjected to various experiments. High pressure endurance runs, for example, are often made, necessitating careful measurements of input, output oil flow, temperature, efficiency, and the like.

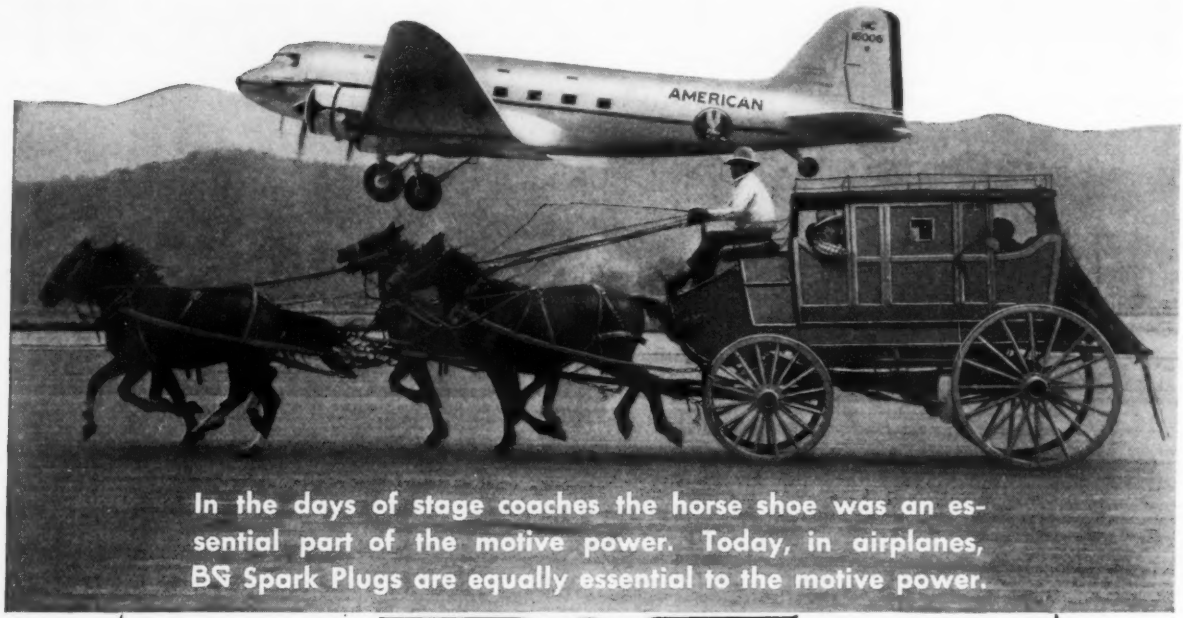
An engineer making adjustments on a test hub during a low-temperature run in the "cold room" in the new laboratory of Hamilton Standard Propellers. Temperatures as low as −50°F. may be created in this chamber.

United Air Lines

An analysis of all the cases of discomfort reported among the 1,084,190 passengers transported during the calendar years 1938, 1939, 1940 by United Air Lines, made by Col. A. D. Tuttle, M.D., indicated increase in passenger comfort. The statistics show that in over a million passengers flown:

Only 1 in 400 had airsickness,
Only 1 in 800 had oxygen want,
Only 1 in 1,300 had ear trouble,
Only 1 in 1,400 had nervousness,
Only 1 in 800 had some miscellaneous discomfort.

The general average of the survey shows that throughout the three-year period 149 out of every 150 persons carried by UAL completed their flight in perfect comfort. In practice, this means that *seven* airplanes in succession can be flown on scheduled trips (e.g., Chicago to New York), with every one of the twenty-one seats in each airplane occupied by a passenger, before the air line meets up with the law of averages and has to reckon with a single case of discomfort aboard.



In the days of stage coaches the horse shoe was an essential part of the motive power. Today, in airplanes, BG Spark Plugs are equally essential to the motive power.

NATIONAL SAFETY COUNCIL
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FOUNDED 1912

THE TRUSTEES'
COMMEMORATIVE SAFETY AWARD
PRESENTED TO

AMERICAN AIRLINES, INC.
THE FIRST AIR TRANSPORT COMPANY
TO OPERATE
ONE BILLION PASSENGER MILES
WITHOUT A FATALITY TO PASSENGER OR CREW
THIS COVERS A PERIOD OF MORE THAN FIVE YEARS
A WORLD RECORD IN SAFE AIR TRANSPORTATION
DESERVING HIGHEST COMMENDATION

W. H. CAMERON
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NEW YORK
APRIL 22, 1941

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Contractors to the United States Army, Navy and Coast Guard and Aircraft Engine Builders
136 WEST 52nd STREET, NEW YORK, NEW YORK

Light Metals and Alloys-II

A bibliography giving references for research in this specialized field. Revised and brought up-to-date from the fifty volume Bibliography of Aeronautics compiled and published with the cooperation of the Work Projects Administration from the Aeronautical Index of the I.Ae.S. References have been classified and cross-indexed. Continued from the May 1941 issue.

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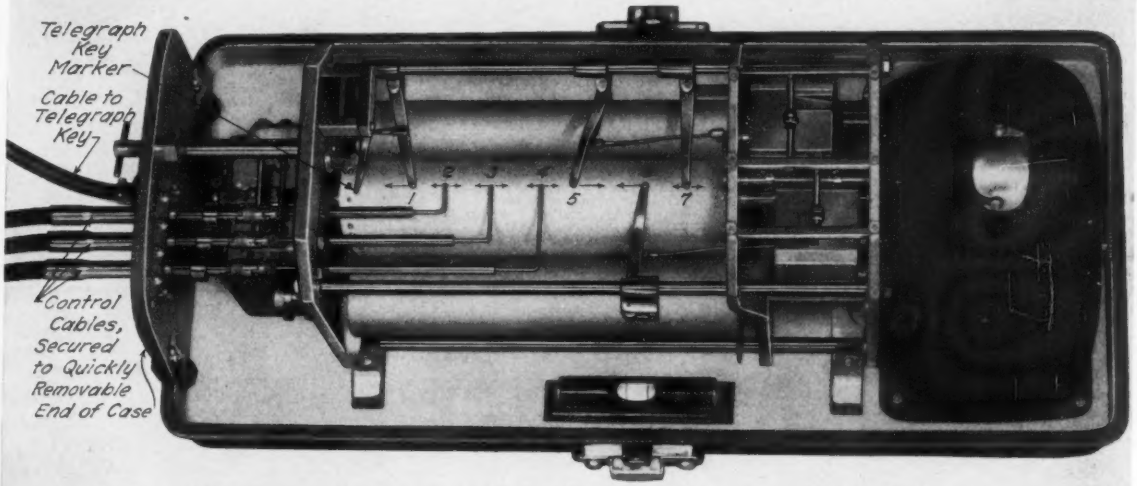

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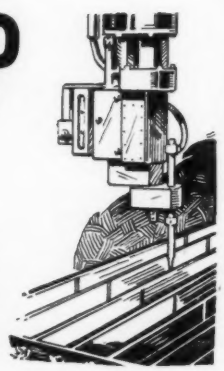

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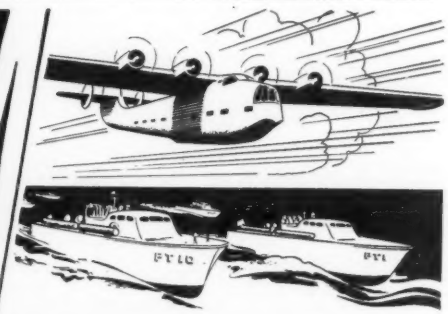

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It is maintained that Germany's war effort is basically dependent upon land transport facilities, particularly in the Balkans, and that the very appropriation by the enemy of such transport systems in "unoccupied" countries should be considered sufficient cause to warrant immediate attack without waiting for more formal evidence of an "act of war." *Flight*, March 27, 1941, pages 239–240.

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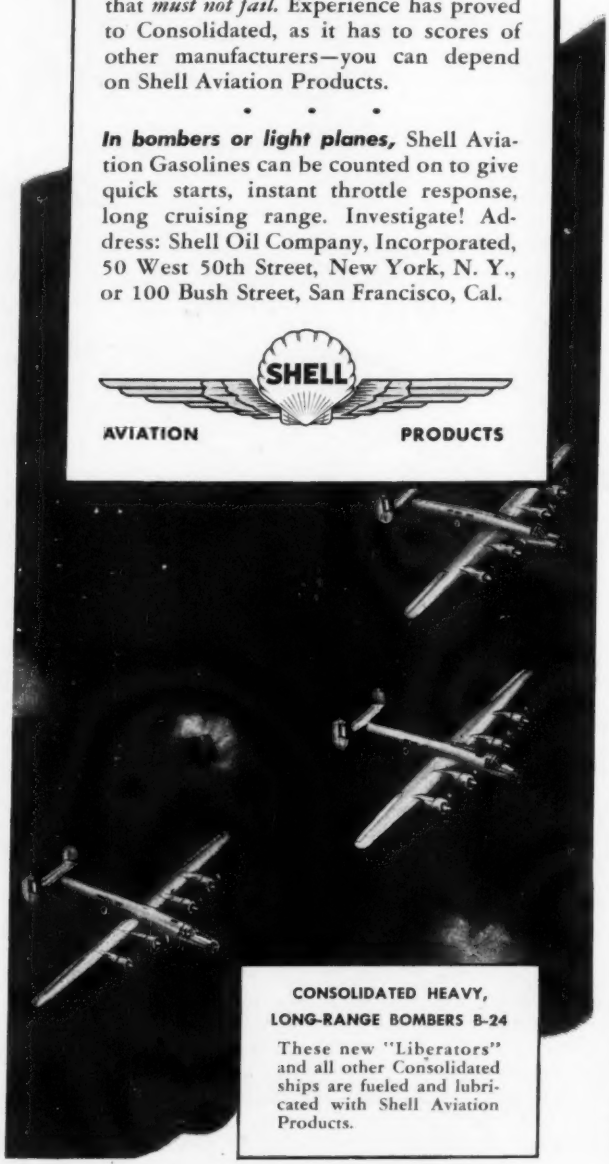

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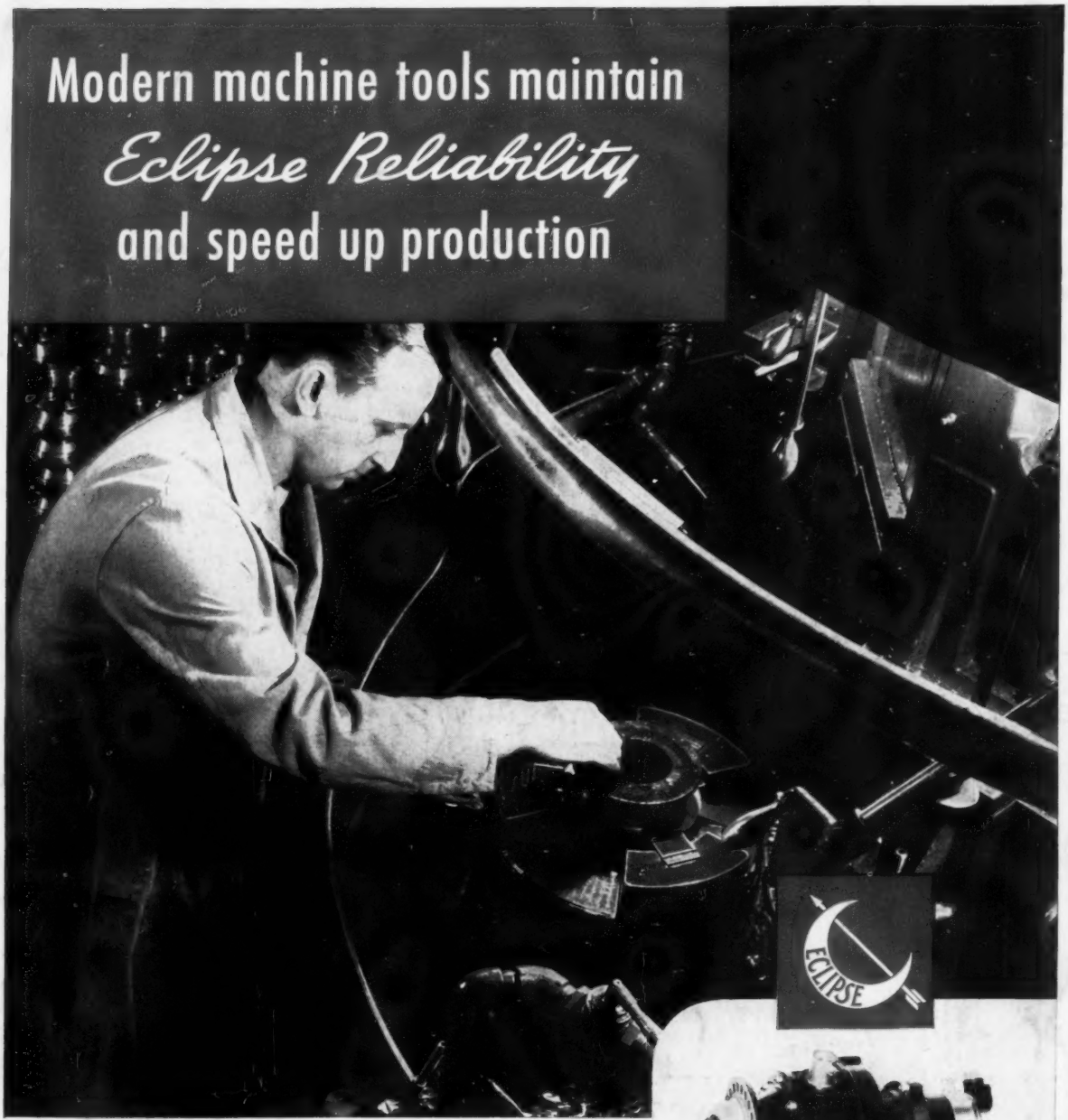

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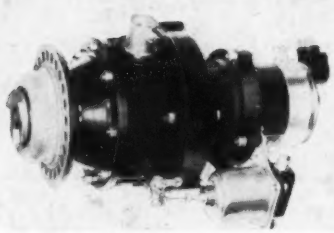

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